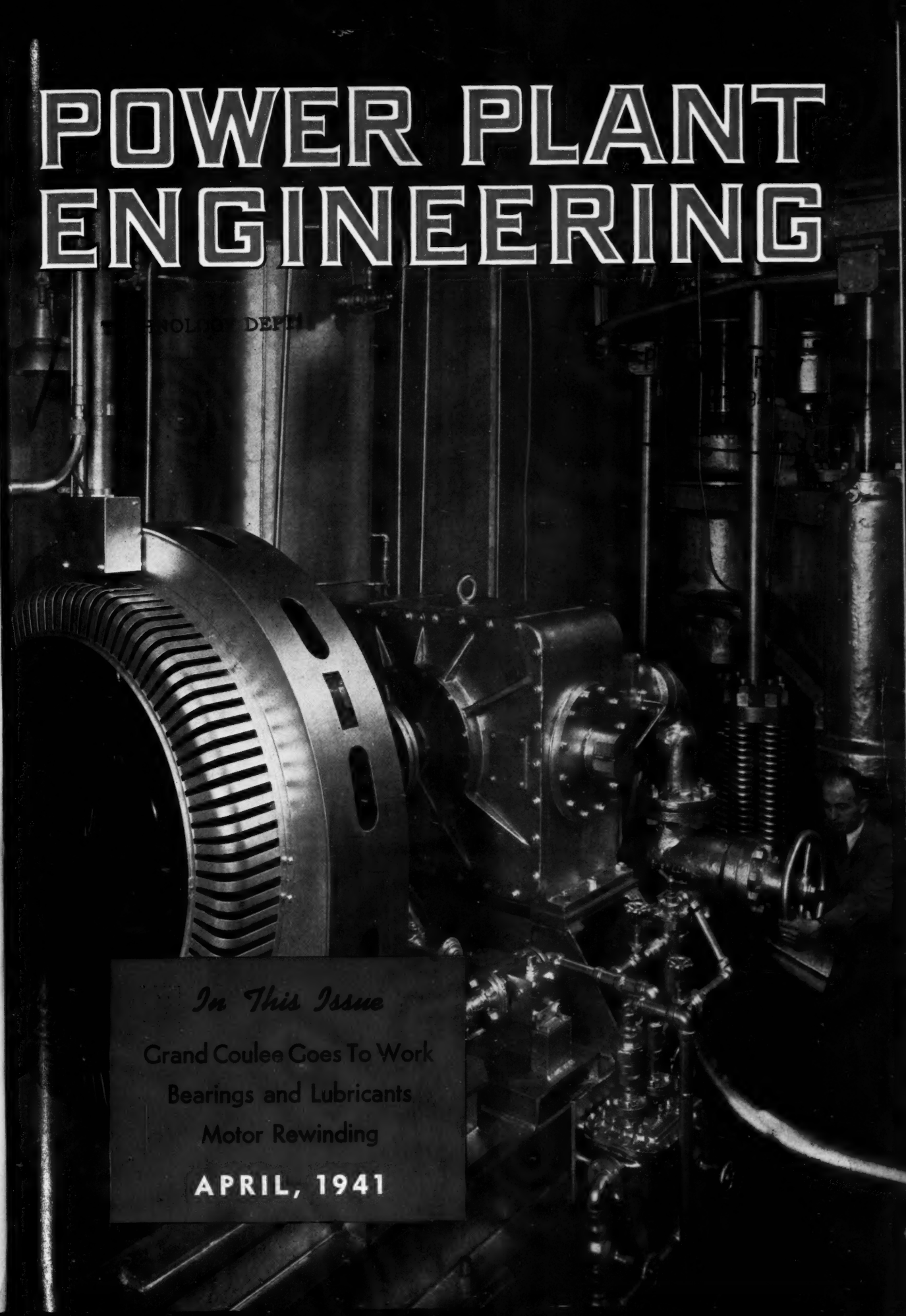
POWER PLANT ENGINEERING



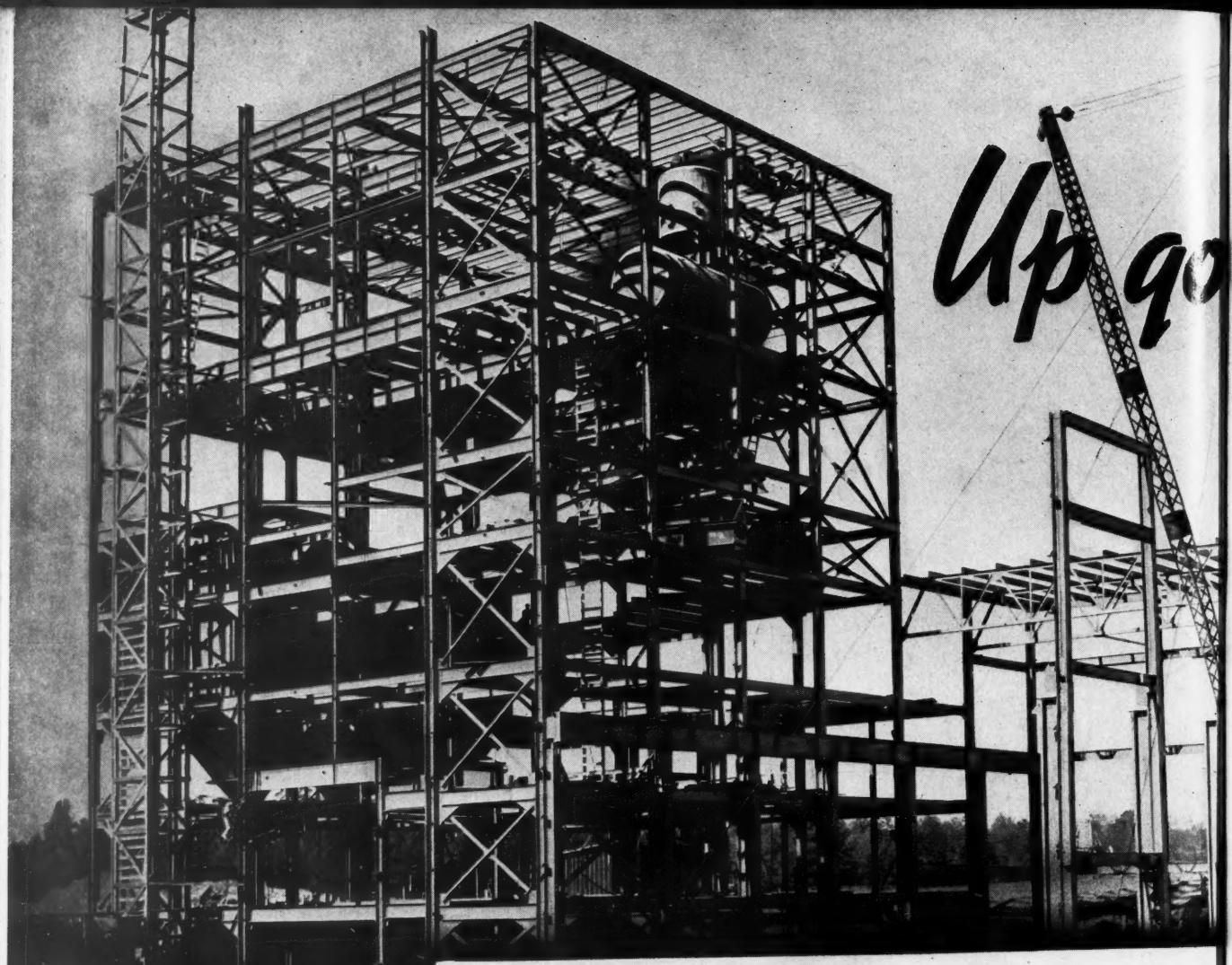
In This Issue

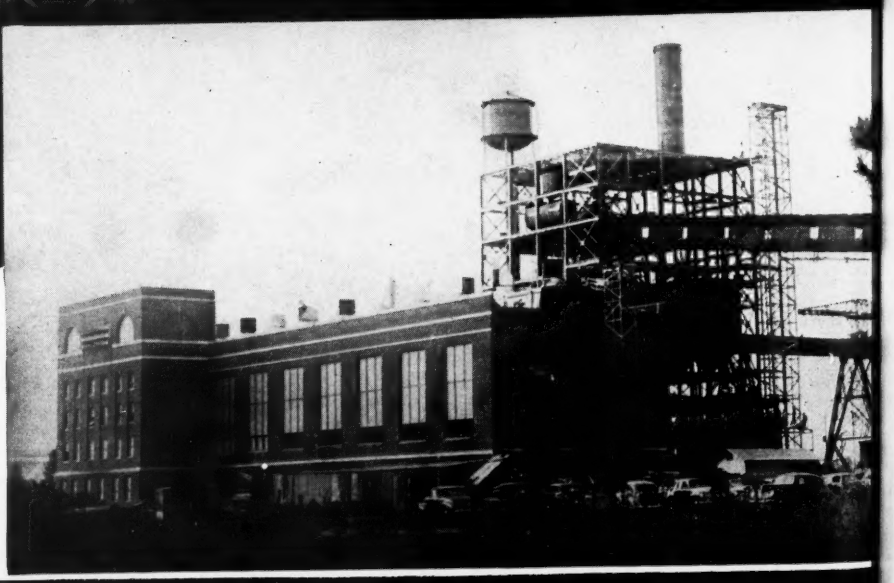
Grand Coulee Goes To Work

Bearings and Lubricants

Motor Rewinding

APRIL, 1941





N-959

ELLIOTT

POWER PLANT ENGINEERING

APRIL, 1941
VOLUME 45, NO. 4

Cover: 300 hp. motor used in operating the world's most powerful testing machine capable of exerting a force of 3,000,000 lb. in compression, and 1,000,000 lb. in tension. It is installed in the research laboratory of the Aluminum Co. of America at New Kensington, Pa.

The Voice of Industry. By James S. Knowlson 47
Grand Coulee Goes to Work 48
With the Editors 49
The New Boiler Plant at the Atlantic Gelatin Co., Inc. 50
Only the Productive Can Be Strong. By L. M. Duryee 55
Bearings and Lubrication. By Vernon M. Huff 56
Inspection and Maintenance System. By Y. C. Lu and T. Sun 59
Equivalent Surface Areas. By G. Campbell Kohlar 62
Trouble Makers in Lubricating Oil. By R. A. Trefethen 64
Calculating Heat Value for Coal. By J. R. Darnell 65
Costs of Conducting Dust Collector Efficiency Tests. By Louis C. Whiton 67
Insulation 68
Recent Developments in Water Treatment. By S. B. Applebaum 69
Grand Coulee Goes to Work 72
'Round About with the Engineering Editor 74
Motor Rewinding. By C. C. Herman 75
Bituminous Coal Research 77
Tires from Petroleum 77
Refrigerating Engineer. By George Holman 78
The Other Fellow's Combustion Equipment. By J. C. De Foe 81
National Roster of Scientific and Specialized Personnel 83
Accumulator Helps Engine Cycle 84
Practical Engineer and Electrician 85
What About Bronze? By John E. Hyler 102
New Equipment 106
Manufacturers' News 116
News from the Field 120
New Engineering Books 134
For the Engineer's Library 140
Power Plant Construction News 146

Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

EDITORIAL STAFF

ARTHUR L. RICE
EDITORIAL DIRECTOR

RALPH E. TURNER
EDITOR

ANDREW W. KRAMER
ELECTRICAL EDITOR

RICHARD H. MORRIS
ENGINEERING EDITOR

PUBLISHED MONTHLY BY

TECHNICAL PUBLISHING CO.
53 W. JACKSON BLVD.

KINGSLEY L. RICE
President

EDWIN C. PROUTY
Vice President

WALTER PAINTER
Vice President

ARTHUR L. RICE
Treasurer

CHARLES S. CLARKE
Secretary

ADVERTISING REPRESENTATIVES

CHICAGO: Charles S. Clarke
53 W. Jackson Blvd., Chicago, Ill.

NEW YORK: John A. Kershaw
Graybar Bldg., New York, N. Y.

PHILADELPHIA: H. G. Wilds
512 W. Clapier St., Philadelphia, Pa.

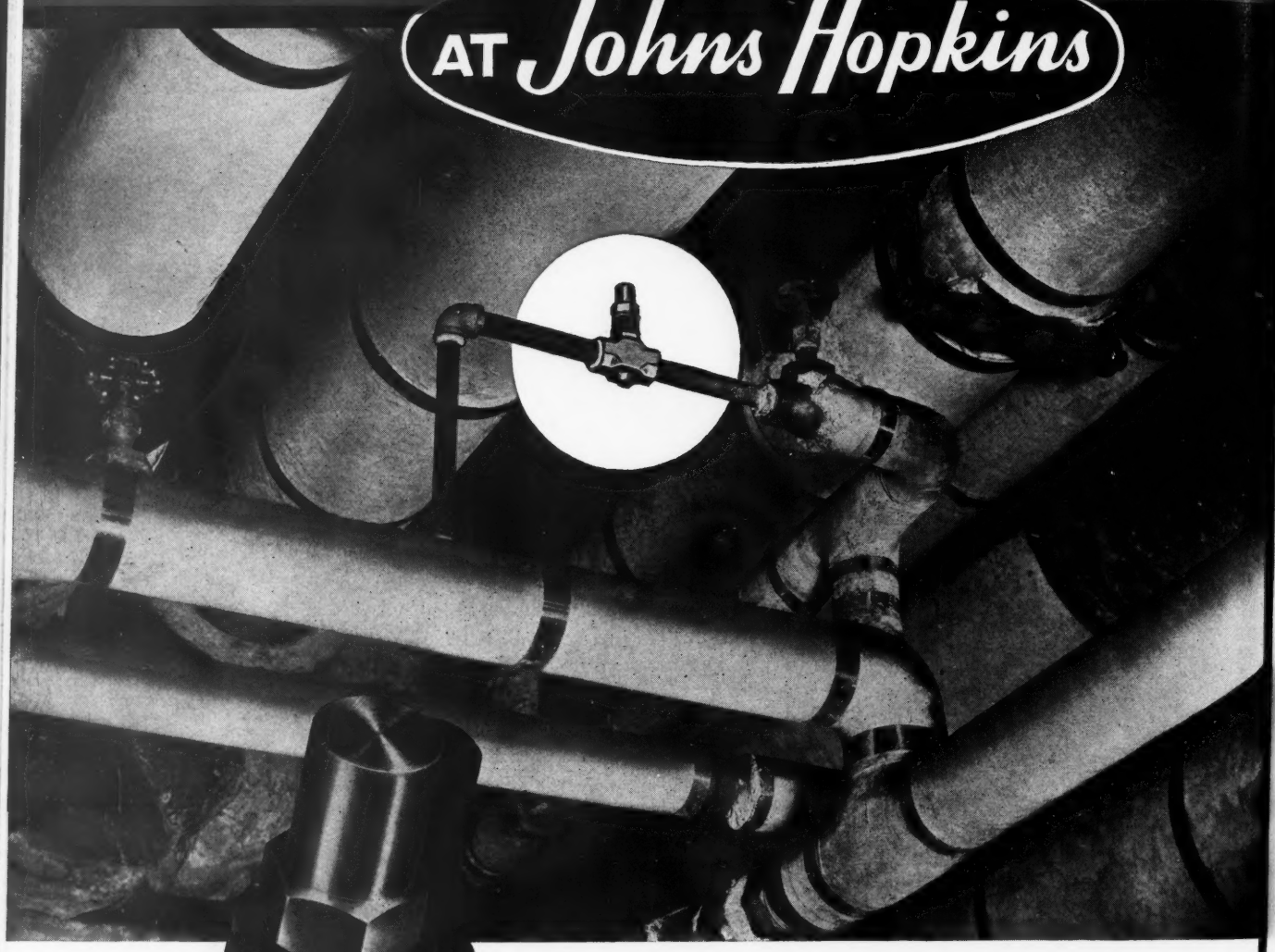
CLEVELAND: George E. Andrews
11733 Edgewater Dr., Lakewood, O.

Subscription price $2.00 a year in the United States and Possessions. Canada $2.75 a year. Other countries $3.50 a year. Single copy current issue 25c; back issue 40c.

Copyrighted 1941 by Technical Publishing Company.

No Trouble or Repairs in Four Years' Continuous Service

AT *Johns Hopkins*



MEET the Yarway Impulse Steam Trap that completed four years at Johns Hopkins University with highest honors.

Reports the Chief Engineer: "No trouble has ever been experienced and no new parts have been installed."

This is one of 15 Yarway Impulse Steam Traps at Johns Hopkins, draining steam lines in the boiler room and tunnels—all giving equally satisfactory service.

It is user satisfaction with the dependable performance, small size, light weight and low cost of this trap that has made it the preference of a constantly growing list of plants of all types—that has put nearly 100,000 of these traps to work during the past four years.

Why don't you investigate the Yarway trap? Ask your Mill Supply distributor or write for catalog T-1735.

YARNALL-WARING COMPANY
114 Mermaid Avenue Philadelphia

YARWAY IMPULSE STEAM TRAP

THE VOICE OF INDUSTRY

JAMES S. KNOWLSON on the SOCIAL AMENITIES AND INDUSTRIAL PRODUCTION

SOMEWHAT over a year ago words began to appear in the public press, words innocent enough to most of you, but having a deep and sinister meaning to those of us who had lived through another war. There are several such words, but I need cite only one—priorities. Unless you have actually danced attendance to Miss Preparedness at a party, you have the idea probably that "priority," as applied to her, is simply one of the social amenities. You imagine that you pass the beans to Miss Preparedness—she helps herself first; you help yourself, and everything is all very nice and polite.

But we have all found out in the last few weeks that Miss Preparedness isn't that kind of girl. When you attend a party with her now, she just yells "priority" and grabs the whole plate—and if the plate happens to be made of aluminum, she eats that too. We realized that sooner or later we were going to be up against the old problem which Mr. Kettering has defined as "the problem of finding out what you are going to do when you can't do what you are doing now."

Looking down this long road ahead of us, we knew that we should have to turn to another customer if we were going to keep our wheels turning. Obviously that customer was the Government, the branches of which are carrying out the preparedness campaign. We had neither contracts nor contacts with the Government—no pull, no political angles. Instead, we had all the problems that any business faces when it decides to venture into a new field.

And so we stepped into bidding on ordnance contracts . . . finally threw our cost estimates under the table . . . We had troubles—plenty but we had no idea that we were making any headway with our new customer. We were pretty low.

Then one day my telephone rang and the commanding officer of Picatinny Arsenal was on the other end of the line . . . We went to Picatinny and we closed the order . . . On the way home we laid our plans for setting up the departments which would be able to produce these items for our new customer as efficiently and as well as our old departments produced for our old customers.

We produced our first order on time. It was hard work. We lost money. We expected to. We got out our second order on time. The strain was less. Slowly our new plan layout began to take shape . . .

Just as we had plenty of troubles which we did not anticipate, just so we did not have some of the troubles that we did expect. We had been fearful of our new customer; fearful of the red tape that we expected to find in the Ordnance Department; of delays; of frequent changes in prints; fearful of having political inspectors who did not know a micrometer from a foot rule.

But instead of finding ourselves up against a lot of bureaucrats or dilettantes, we found we were dealing with men who knew exactly what they wanted and when they wanted it. Men who understood their problems and ours. Their prints were good, and changes so infrequent as to be disregarded; their inspectors so intelligent and efficient that we quickly placed our own inspectors under their direction. All in all—we ask for no better customer with whom to deal than the Ordnance Department of the United States.

I have heard a good deal of criticism of the inefficiency of various branches of the Government. From our own personal experience with the Ordnance Department, I am inclined to think that anyone who attempts to prove that the men there don't know where they are going, or how to get there, may have his ears pinned back.

While for several months I have been able to say that the plant was in operation, since the twenty-seventh day of February I have been able to say that we are in production. And so ends the confession of a war contractor . . . This is a typical report, not an exceptional one, and I really do stand before you as an example of what is going on all around us. This great industrial plant of ours is beginning to turn slowly, laboriously. With groans and creakings it is beginning to move. Each day now an increasing number of men can step forward and say, "We are in production."

When this great army gets swinging to its task, we shall be able to produce enough material to make America safe and have enough left over to push dictators and dictatorships off this terrestrial globe and into the realm of world history —if that be your wish.

JAMES S. KNOWLSON, president and board chairman of the Stewart-Warner Corp. has twice played an active role in the maelstrom created by the abrupt change in direction of industry from peacetime to wartime conditions. Backed by experience and sound judgment he was one of the first to bring order out of chaos and very appropriately outlined these experiences at the National Defense Dinner, in the Grand Ballroom of the Palmer House in Chicago on March 17, for the Army Ordnance Ass'n., the Illinois Mfg. Ass'n. and the Illinois Mfg. Costs Ass'n.

"I should like to tell you," he said facetious, "that we went after defense program contracts inspired by a high degree of patriotism and the hatred which all free men feel for a dictatorship; that we were determined to beat our grease guns into cannon and use our Alemite fittings for shrapnel—but that is not the case."

It was a case of meeting new conditions—the needs of a new customer. It was done, not without trials and tribulations, but with a high degree of satisfaction on both sides. More important in view of what has been said in the past about lack of preparedness plans, "We found we were dealing with men who knew exactly what they wanted . . . their prints were good . . . they understood their problems and ours."

Grand Coulee Goes To Work

GRAND COULEE DAM, the greatest structure man has made on earth, went to work at noon on March 22 last. Called to the colors 2 yr. ahead of schedule by vital defense demands for power this giant power development began to convert the flow of the Columbia River into electrical energy for the use of man on that date. A dream of half a century, in less than 8 yr. whole roomsful of blueprints have been translated with steel and concrete into a cleanly symmetrical, strongly beautiful structure that may well epitomize our generation and our age in the distant years to come. The generator started on March 22 was only a small one, the first of the two 10,000-kw. units which form a very small part of the projected total plant, but it is a beginning, and other units will be completed quickly. In the picture above, Frank A. Banks, Supervising Engineer of the Bureau of Reclamation, who has been in charge of the work throughout the construction of the dam, turns the knob which started the operation of the first 10,000-kw. generator. When the two power plants are completed the dam will develop 2,700,000 hp., the largest single source of energy on this planet, the largest by so wide a margin, in fact, that the 1,835,000 hp. of second place Boulder Dam seems dwarfed by comparison. A pictorial history of Grand Coulee Dam is presented on page 72.

WITH THE EDITORS

◆**HEADS YOU WIN** . . . Said a prominent engineer recently before the A.S.M.E. "The budget and market analyses are twin tools of good management. No business can be considered progressive that does not use them both."

The budget is one thing—market analysis quite another, differing not a great deal from horse racing. It is one of the basic factors of successful business, long on words but short on facts. A. C. Nielson, an engineer well known in engineering circles a few years ago through the Nielson Surveys, now better known among business men for the Nielson Food, Drug, Liquor and more recently Radio Indexes, has built up an organization which reduces market analysis to facts and figures.

About the same time the above remark was made in New York, Hugh L. Rusch, executive vice president of the Nielson organization was saying in Chicago that: "Our box score of executive judgment indicates about 42 percent of marketing decisions are wrong." Apparently the business man has a long hard climb to reach the level of accuracy of even a mediocre engineer and the bright young engineer might do well to take a serious look at the growing field of market analysis.

◆**OSTRICH TACTICS** . . . "National Defense—you know—National Defense." This Hugh Herbert attitude is becoming increasingly evident, so evident in fact, that some time ago it was taken up with the Advisory Commission on National Defense. In reply copies of earlier correspondence with a manufacturers' association was quoted with the notation by Robert W. Horton, Director of Information, that "You will note from this correspondence that no statement was made 'on tightening up because the government might not like it.'" The correspondence mentioned follows and it is evident that National Defense is a poor alibi for secrecy.

"We are heartily in accord with your idea of giving out press releases on the progress being made . . . on defense orders. We believe that you can do much to give the public a clear conception of the processes, problems, and progress in defense. The only thing we caution you against is where the orders are of a secret and confidential nature. If this is the case, the manufacturer will have already been informed of this by the War or Navy Department."

◆**OUTDOOR CONSTRUCTION.** . . . A decade ago following the lead of hydro plants, outdoor construction for steam plants was a live topic of conversation, one offering a material reduction in superstructure costs ranging up to 10 per cent of the total plant costs.

Several prominent outdoor installations were planned, but about this time the depression put a temporary damper on interest in new plants. This was followed by the topping era largely in existing buildings, by the high temperature plants in which the superstructure cost is a smaller proportion of the total, and what is probably more important, the realization, especially by the utilities, that a power plant should be functional and not necessarily a civic monument.

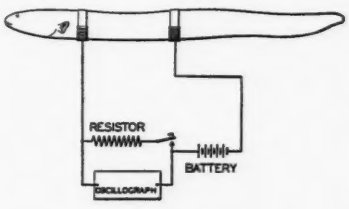
As the importance of the superstructure dwindled, the clamor for outdoor construction subsided, but the savings in construction costs impelled a good many to adopt it to some extent. There were about a dozen semi-outdoor plants, with either the boilers or turbines outside and probably as many more where certain parts or auxiliaries are outside. Due to the lower costs this practice will certainly become increasingly common.

Saving made in construction is, however, at the expense of operating convenience. Operators do not favor it and it has been definitely determined that if equipment is to receive regular attention in bad weather some kind of protection must be provided for the operators.

Up to now little attention has been paid to developing a true outdoor construction, too much of a tendency to consider that indoor arrangement and construction with the building simply omitted was sufficient. With further experience, a true outdoor construction, with auxiliaries, valves and piping better arranged will be developed. A few have already taken a page from the experience of refineries where outdoor construction has been common for years.

◆**ELECTROPHORUS ELECTRICUS** . . . Electric eel to you—doesn't worry much about steam pressures and temperatures but was an old timer in the electrical business when Faraday investigated him quite thoroughly over 100 yr. ago. Mr. Eel, who is not a true eel but a relative of the carp or catfish and who will drown if kept from gulping air, grows from 6 to 8 ft. in length and has a generator which extends about 4/5th the length of his body.

Peaks of almost 300 v. have been measured on relatively small specimens, and peak power outputs (at about 150 v.) up to 40 watts. The voltage wave begins at the front of the generator and travels toward the tail at a speed of about 3250 ft. per sec. (approximately 2250 mi. per hr.) although speeds of more than double this have been observed. The shocks persist about 0.002 sec. and come in series of one minor followed by 3 to 6 major shocks about 0.005 sec. apart.



Doubting Thomases, we refer to Dr. Cox of the Physics Department of New York University, who with other scientists from New York to California, has made quite a study of these old fashioned generators; ironically enough by means of the ultra modern oscillograph.

New Boiler Plant At The

New Steam Plant Built to Serve Large Gelatin Factory at Woburn, Massachusetts, has been delivering 1,400,000 lb. of steam per day during the 6 months of its operation at an average overall boiler efficiency of 84.5 percent. The boilers are oil fired and under complete automatic control. Steam is generated at 100 lb. pressure

THE ATLANTIC GELATIN COMPANY, INC., recently completed construction of a new steam plant to supply steam for heating and process work in its factory at Woburn, Mass. Woburn is about 15 mi. out of Boston. This steam plant is noteworthy because of its compactness and the fine attention to detail observed in its design and construction. Simple and direct in its layout, modern to the last detail, spotlessly clean and bright, it presents an unusually attractive appearance, reflecting a high degree of skill and knowledge on the part of its designers. The plant was finished last summer and during the 6 odd months that it has been in service it has been producing around 1,400,000 lb. of steam per day with an average overall boiler efficiency of 84.5 percent. The boilers are oil fired and steam is generated at 160 lb. pressure.

For many years the Atlantic Gelatin Co. purchased steam for this factory at Woburn from the Eastern Massachusetts Railway System. The traction company had an old electric generating plant adjacent to the gelatin company property and this plant supplied both steam and electricity to the gelatin factory.

In recent years, however, the electric traction system was gradually replaced by a bus transportation system and as a result of this change the electric generating equipment was finally shut down. The steam plant was retained, however, and it continued to supply steam to the gelatin plant. From that time on electricity was purchased from the Boston Edison Co.

The situation was not of the best, however; the steam plant was old and the continuance of the arrangement was never assured. It

Fig. 1. (Left) The two turbine driven boiler feed pumps

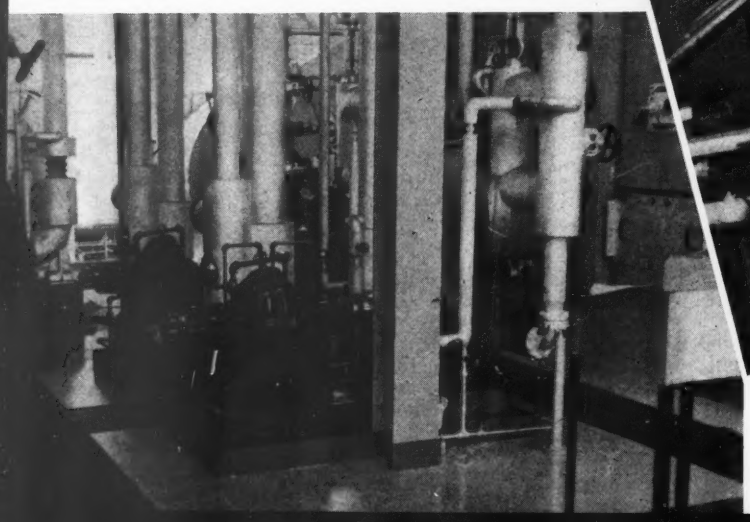


Fig. 2. (Above) View from the oil burner platform of one of the boilers, showing the other boiler

Atlantic Gelatin Company, Inc.

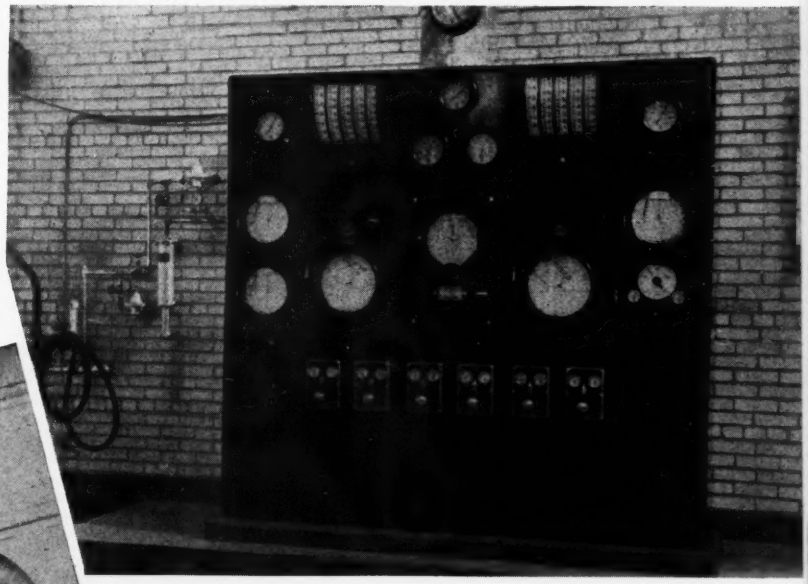


Fig. 3. (Below) A view on the F. W. Heater level back of the boilers showing breeching to the stack

Fig. 4. (Right) The boiler control panel. The automatic combustion control, as well as the manual control of the boilers, is centered on this board

was finally decided, therefore, to build a new steam plant.

Since the main purpose of this plant was to supply steam for heating and process work to the factory, a comparatively low boiler pressure was needed. A pressure of 160 lb. was ample, but with a view toward the possible installation of turbo-generating equipment at some future time, it was deemed expedient to buy boilers capable of being operated at a higher pressure than the 160 lb. per sq. in. needed at the present time. So boilers built for a working pressure of 300 lb. were selected.

General Design

The general design of the new boiler plant is shown by the accompanying drawings and some of the details are evident from the photographs. The building itself is simple but attractive in appearance and occupies an area 57 by 63 ft. Figure 5 shows the the location of the boiler house with respect to its surroundings Two 50,000 gal. fuel oil storage tanks placed within an enclosing dike are located along a railroad siding and the boiler house occupies a position approximately midway between these tanks and the factory building immediately to the south.

Steam is transmitted from the boiler house to the factory buildings by overhead pipe lines carried on steel supports 20 ft. high. Three lines are provided, one 10 in. line and two 4 in. lines. An outdoor transformer substation is located just outside the boiler house; this reduces high voltage primary power to the voltage used in the factory. The stack is supported on a separate foundation a few feet away from the building.

The arrangement of the boilers, boiler feed pumps, forced and induced draft fans and feedwater heater is symmetrical and convenient for good operation. The

boiler feed pumps and the forced and induced draft fans are all located on the operating floor which is at grade level and the feedwater heater is placed on a platform above the feed pumps. The boiler control board is placed in front of the boilers, centered between the units as shown on the plan view.

The two boilers are Combustion Engineering Co. Type "VU" units, each with 6340 sq. ft. of surface

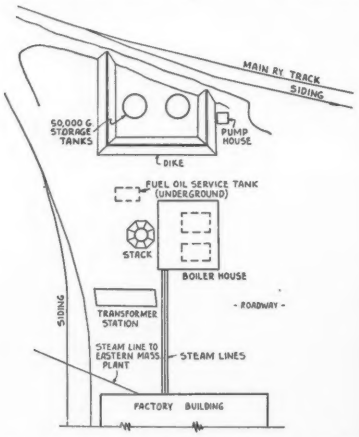


Fig. 5. Plot plan, showing relative location of the boiler plant with respect to other structures

in the boiler proper and 1406 sq. ft. of water wall surface in the furnace, a total of 7746 sq. ft. in each unit as a whole. The air heaters each have 4410 sq. ft. of heating surface. The furnace volume is 2730 cu. ft.

As already mentioned, while these boilers operate at 160 lb. per sq. in. at the present time, they are built for a working pressure of 300 lb. per sq. in. They have a rated capacity of 65,000 lb. of steam per hr. each, and the efficiency of the boiler, furnace and air heater at maximum rating is 85.3 percent.

Each boiler is provided with a forced and induced draft fan and the complete installation operated under complete automatic control by a Bailey control system. An interesting feature of the draft system is the fact that the forced and induced draft fan for each boiler are on a single shaft and driven by a single prime mover, a steam turbine. The turbines drive the fans through reducing gears.

The automatic combustion control system controls the oil flow to the burners and the flow of forced and induced draft air in accordance with the steam pressure. The automatic control acts on dampers in the air ducts, the speed of the fans remaining constant over a given range of loads. The turbines driving the fans are provided with a manually operated remote control, so that the operator can adjust the fan speed from the boiler control board. For a given range of load the speed of the turbine is set more or less by the requirements of the forced draft fans.

Each boiler has 4 Wolley oil burners installed in the front wall of the furnace. The oil is delivered to the burners by 2 De Laval 2 in. suction, 1½ in. discharge rotary pumps, one motor driven and the other turbine driven. These are designed to handle commercial bunker C oil at 80 to 150 deg. F. Each of these pumps has a capacity of 5000 lb. of oil per hr.

The fuel oil is stored in the two 50,000 gal. tanks already referred to. From these storage tanks it

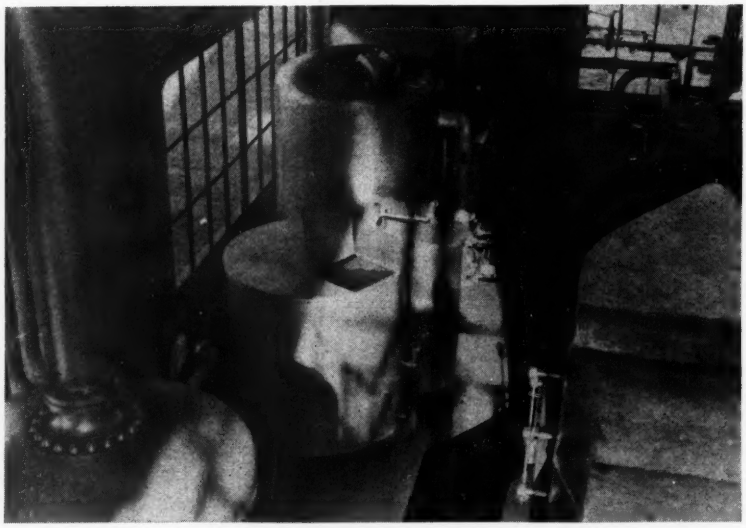


Fig. 6. View from above, looking down on the zeolite water treating equipment

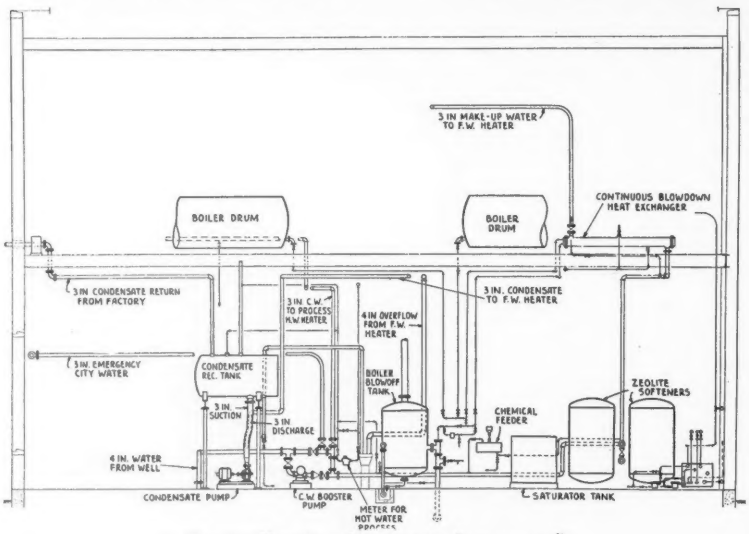


Fig. 11. Elevation of equipment along rear wall

is pumped to the underground fuel oil service tank close to the building by pumps installed in a small pump house adjacent to the storage tanks. From the underground service tank the oil is withdrawn by the fuel oil pumps in the boiler room, heated, and delivered to the burners. The two fuel oil heaters operate in parallel and are controlled by a Foster pressure regulator to maintain an oil temperature of 230 deg. F. The fuel oil pumps together with the heaters are installed along the side of one of the boilers. A Pneumericator tank gage at the pump indicates the level of the oil in the service tank at all times. The service tank is equipped with steam heating coils around the suction pipe.

Boiler auxiliaries installed include, Diamond soot blowers, Yar-

way water columns and blowdown valves, Consolidated safety valves and Edward stop and check valves.

Instruments on the boiler control panel besides Bailey boiler meters and controls, include Hays draft gages, Ashcroft indicating steam gages, Republic flow meters and Foxboro pressure and temperature recorders. The boiler control board is neatly designed and all pressure and control piping leading to it is enclosed in a steel enclosure.

A continuous blowdown system is provided to keep the boiler water concentration down to desired levels. The heat in the discharge from this system is recovered in a 6 in. Paracoil heater mounted on one of the upper gratings at the rear of the boilers. The amount of blowdown is measured by a Henszey water meter.

The feedwater used at the plant is well water which averages around 8 gr. of hardness per gal. This water is softened in a Wm. B. Scaife zeolite softener, the equipment consisting of 2 zeolite treating tanks, a saturator tank and the necessary pumps and filters, all located along the rear wall of the boiler plant. It is rated at 201,000 gr. which with water of 8 gr. hardness gives a daily treating capacity of 25,000 gal.

Since much of the steam generated is used for process work in the factory, the make-up requirements are comparatively high; it has been averaging around 53 percent.

Two boiler feed pumps are provided; these are De Laval centrifugal units, each with a capacity of 150 g.p.m. of 250 deg. F. water against a 550 ft. head at 3600 r.p.m. and driven by 38 hp. Elliott turbines. As shown on the drawings, the boiler feed pumps are located between the boilers and deliver the water to the Elliott deaerating feedwater heater installed on the platform above. This heater is of the storage type having a water capacity of 10,000 lb. and is designed to heat 35,000 lb. of make-up water per hr. from 54 deg. F. to 250 deg. F. and 30,000 lb. of condensate from 180 to 250 deg. F.

The delivery of feedwater to the boiler and the water level in the

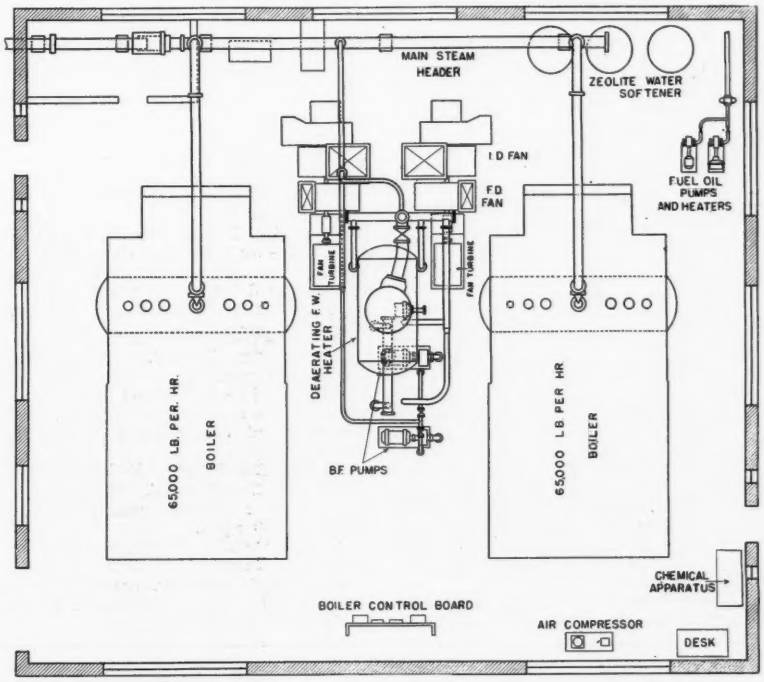
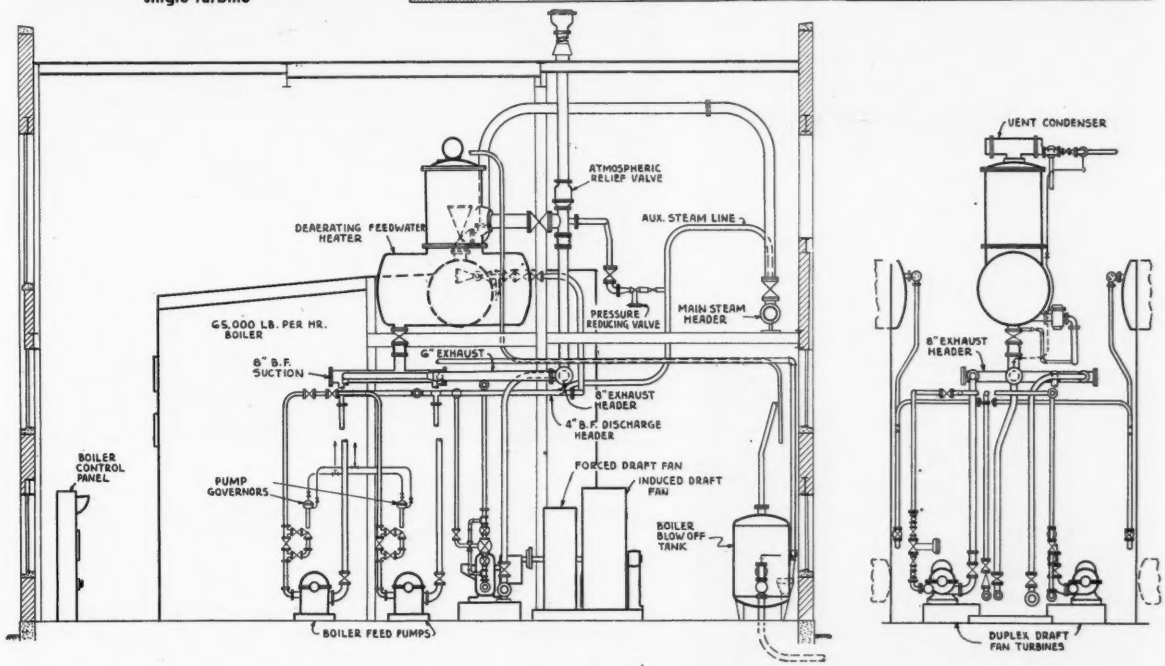


Fig. 7. (Right) Plan showing general arrangement of equipment

Fig. 8. (Below) Sectional view through center of the building. The Forced and Induced draft fans are on one shaft driven by a single turbine



PRINCIPAL EQUIPMENT IN THE STEAM PLANT OF THE ATLANTIC GELATIN CO., INC.

General

OWNERS—Atlantic Gelatin Co.
LOCATION—Woburn, Massachusetts.
SERVICE—Industrial Steam Plant.
CAPACITY—130,000 lb. of steam per hr.
FUEL—Oil.

Boiler Equipment

BOILERS. Combustion Engineering Co. 2—Type V.U. 300 lb. W.P. Capacity 65,000 lb. per hr. Boiler H.S. 6340 sq. ft. Water wall H.S. 1406 sq. ft. Total 7746. Furnace volume 2730 cu. ft.

AIR HEATERS. Combustion Engineering Co. 2—4410 sq. ft. units.

COMBUSTION CONTROL. Bailey Meter Co. 1—Compressed air operated control equipment and control panel for 2 oil fired boilers.

DRAFT FANS. B. F. Sturtevant Co. 2 duplex fans. Each consisting of a No. 90 Turbovane F.D. draft fan and a No. 95 Turbovane I.D. fan on a common shaft. Capacity F.D. fan 67,300 lb. at 100 deg. F. = 15,900 c.f.m., 7.0 in. S.P., 1200 r.p.m. Capacity I.D. fan, 81,600 lb. at 380 deg. F. = 28,000 c.f.m., 3.6 in. S.P., 1200 r.p.m.

Draft Fan Drives. Elliott Co. Each duplex fan unit is driven by a 55 hp. Elliott 2-BY turbine with built-in gear, complete with governor, overspeed trip relief valve, steam separator and low speed coupling.

BLOW-OFF VALVES. Yarnall Waring Co.

SAFETY VALVES. Manning, Maxwell & Moore, Inc. Consolidated valves on two boilers.

WATER COLUMNS. Yarnall Waring Co.

FEEDWATER REGULATOR. Bailey Meter Co. 2—Thermo-hydraulic F.W. regulators capable of passing 86,000 lb. of water at 210 deg. F. with a pressure drop of 35 lb. per sq. in.

SOOT BLOWERS. Diamond Power Specialty Corp.

FEEDWATER, STOP AND CHECK VALVES. Edward Valve & Mfg. Co.

BOILER NON-RETURN VALVES. The Wm. Powell Co.

Fuel Oil Equipment

FUEL OIL STORAGE TANKS. Graver Tank and Mfg. Co. 2—20 ft. by 21 ft. 6 in. outdoor tanks. 1—9 ft. 6 in. by 23 ft. 11 in. underground oil service tank.

FUEL OIL STRAINERS. Coen Co. 1—duplex 1¼ in. discharge strainer. 1—duplex 2 in. suction strainer.

FUEL OIL PUMP. De Laval Steam Turbine Co. 2 I M O rotary pumps. Capacity each 5000 gal. oil per hr., one driven by Westinghouse motor, the other by an L. J. Wing Mfg. Co. steam turbine.

FUEL OIL HEATERS. Griscom Russell Co.; Davis Engineering Co.

FUEL OIL TEMP. AND PRESS. REGULATOR. 1 Foster Engineering Co. Combination type to handle saturated steam at 150 lb. at a flow of 600 lb. per hr. and to control temperature of oil at 250 deg. F.

ELEC. FUEL OIL HEATERS. Cutler-Hammer, Inc.

FUEL OIL METER. S. F. Bowser & Co. 1 Bossler 1 in. fuel oil meter with porcelain counter wheels. Range 60-300 deg. corrected for 60 deg. temp.

OIL BURNERS. 4 per boiler. Wolley.

Water System

FEEDWATER HEATER. Elliott Co., Deaerating type. Storage capacity 10,000 lb. Designed to heat 35,000 lb. of make-up from 54 deg. to 250 deg. F. and 30,000 lb. of condensate from 180 to 250 deg. F.

BOILER FEED PUMPS. De Laval Steam Turbine Co. 2 centrifugal, 150 g.p.m., 250 deg. F. water against dynamic head of 550 ft., 3600 r.p.m.

BOILER FEED PUMP DRIVES. Elliott Co. 2—38 hp. Elliott 2-BY steam turbines, complete with governor, overspeed trip, steam strainer, relief valves and differential pump governor.

WATER SOFTENER. Wm. B. Scaife & Son. Zeolite softener rated at 201,000 gr. Average capacity 70 g.p.m.

CONTINUOUS BLOWDOWN HEAT EXCHANGER. Davis Engineering Co. 1—6 in. Paracoil straight tube type.

BOOSTER PUMP. Worthington Pump & Machinery Corp. 1 horizontal volute single stage pump.

WATER METER. L. E. Merritt & Co. 1 Henszey F. W. meter for continuous blowdown system.

PROCESS HOT WATER HEATER. Whitlock Mfg. Co. Type S straight tube, floating head instantaneous heater. 60 g.p.m. from 54 to 180 deg. F. when supplied with steam at 5 lb. pressure.

CONDENSATE PUMP. 1 Micro Westco, Inc., pump, capacity 65 g.p.m., 180 deg. F.

Miscellaneous

INSTRUMENTS

2—Bailey Boiler Meters—steamflow—airflow.

1—Republic, electrically operated steamflow meter to record steamflow in main 10 in. steam header.

1—Foxboro. Combination pressure and temperature recorder.

5 — Ashcroft-American, Duragages. Manning, Maxwell & Moore.

2—Hays 5 pointer draft gages.

PIPING. Piping in the boiler house and distribution lines to factory. Lunsden and Van Stone Co.

ATMOSPHERIC RELIEF VALVE. Cochrane Corp. 1 relief valve set to maintain 10 lb. pressure in deaerating heater.

PRESSURE REDUCING VALVE. Foster Engineering Co. 1 pressure reducing and regulating valve to control live steam make-up to deaerating heater.

CHIMNEY. Rust Engineering Co.

BOILER HOUSE ERECTION. F. Leroy Fox, Inc.

BOILER EQUIPMENT ERECTION. Hooper Boiler Setting Co.

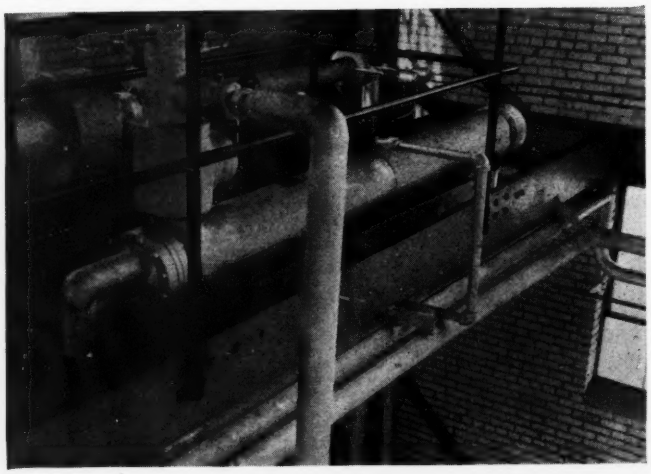


Fig. 9. (Left) Chief operating engineer, Albert A. Fava making a water analysis. This chemical equipment is used to make boiler water analysis several times a day; treatment is regulated accordingly

Fig. 10. (Above) The continuous blowdown heat exchanger. This heater is compact and is installed on one of the gratings high up at the rear of the heater room

boiler is controlled by Bailey Thermo-hydraulic feedwater regulators.

Condensate collects in a 42 in. diameter tank mounted on 7 ft. 8 in. steel supports back of the boilers. From this tank a motor driven pump delivers the water to the feedwater heater. The condensate tank is also provided with a connection to the city water mains so that a source of water is available in case the well water supply fails. A small booster pump pumps the well water, or the city water, to the zeolite softener. Another line goes directly to a Whitlock Type S straight tube instantaneous water heater. This heats water from a temperature of 54 deg. F. to 180 deg. F. at a rate of 60 g.p.m. when operating at 5 lb. steam pressure and heats water for process work in the factory.

The deaerating feedwater heater is normally supplied with exhaust steam from the steam driven auxiliaries, but in case this is not sufficient, provision is made to supply steam from the main boiler header.

On the whole, the piping arrangement is simple and symmetrical. A line from each boiler connects into a main steam header at the rear of the boiler room and the auxiliary lines are tapped off from that.

Little more need be said about the constructional features of this plant; the drawings and particularly the photographs speak for themselves. In appearance it is representative of everything a truly modern plant should be and its 6 months' operating record mentioned at the beginning of this article testifies to its good engineering design. The oil burned runs 18,450 B.t.u. per lb. and with this fuel an average evaporation of 15.65 lb. of water per lb. of oil is maintained. The equivalent evaporation is 16.12 lb. per lb. of oil. As pointed out before, the average overall efficiency has run 84.5 per cent.

The plant is operated under the direction of J. H. Cohen, who is vice president and general manager. Mr. Cohen founded this business in 1919 and is responsible for its present position in the industry. Albert A. Fava is chief operating engineer. The fine operating record is due largely to his thorough understanding of the equipment and his constant attention to detail. He has a loyal organization and has installed many minor but important devices, all of which contribute to the good operation of the plant as a whole.

Fig. 12. "Old man furnace" himself. A view from the inside of one of the furnaces showing the four oil burners in the front wall

Typical of the latter are the quadrants on the draft dampers. While it is unlikely that the automatic draft control equipment should fail, still it is possible; so, Mr. Fava has attached levers to the forced and induced draft damper shafts and calibrated their positions at various loads. Thus even if the automatic draft control should become inoperative, the draft dampers could still be set manually at the proper positions for the existing loads.

Only the Productive Can Be Strong

By L. M. Duryee

DURING the early 1930's the Technocrats raised their voices in loud protest against unemployment which was created—so they said—by the machine. This same hue and cry has been heard continuously ever since then. In fact, it undoubtedly was heard just as distinctly back in the time of the ancient Pharaohs.

Any protest against the modern machine is a protest against modern power. For without power development, machines would be utterly useless. But does the record of fact indicate that power-driven machines put men into the bread line? Earnest students of technology have argued that they do. Let us see.

Back in 1769, in England, it took 320 men to weave the cloth that one man could weave in 1840 on improved machines. So by 1840 there was a great hubbub. Weavers, upset and disturbed, tried to throw monkey wrenches into the smooth running machines which had "robbed them of their jobs."

What actually did happen? Between 1830 and 1914, the number of weavers employed in England rose from 195,000 to 689,000! During this period the population of England doubled, but the number of weavers brought into the textile industry as a result of power-driven machinery increased three and a half times.

The simple fact is that power-driven machinery lowers costs so drastically that more goods are sold. This, of course, means that more workers are needed to make the goods, service the goods, transport the goods, and sell the goods.

In America, between 1870 and 1930, the population of our country increased with extreme rapidity. Jobs increased in this industrial age even faster. Population increase was 218 per cent; number of people employed by industry increased 291 per cent.

Power-driven labor-saving machines have raised the standard of living of Americans above that of any other people on the face of the earth. Power-driven machines have actually created more jobs than any other single development.

The plea of the worker and the industrialist alike in these days of international chaos should therefore be "More machines—and more power to the machine." It is in this way that America has become so productive and so strong. And as some one has aptly put it, "Only the productive can be strong and only the strong can be free."

BEARINGS AND LUBRICATION

Destructive wear of machine bearings results from sliding friction. Proper lubrication means the use of lubricants best suited for the purpose and applied in a manner to produce an adequate oil film between the moving surfaces. The friction of metal on metal is thereby reduced or removed. Proper lubrication reduces power loss, increases production, lowers costs and increases profits

By VERNON M. HUFF

PROPER LUBRICATION increases the earning power of a plant by eliminating delays and down time caused by trouble with bearings, cylinders, gears, packing and other frictional surfaces. Lubricants are made for the many and varied requirements of every type of machine. New methods of application are being developed. Research and development are constantly raising the standards of lubrication products.

About one hundred years ago a soft metal was developed by Isaac Babbitt who patented it as a bearing lining, combined with a shell or supporting block. Since that time soft metal alloys have been used as bearing metals for plain bearings. These metals are known under various trade names but are commonly called Babbitt metals. The purpose and reason that Babbitt or soft metal alloys are used so widely is that they are easily and cheaply replaced and form readily to the shape desired. They are softer than the shafting and absorb most of the wear.

Babbitt metals, being easy to work, have led to careless methods and practices in their use. They are often poured in bearings, using the shaft spindle as the mandrel for the bearing. This is possibly the worst practice in its use. It softens the shaft and forms a rough bearing. In practically every case the shaft is worn and often scored at the spindle. Soft metal should always be poured on mandrels. Blocks and mandrels should be heated to about 220 deg. F. before pouring the metal. If this is not done, the result is apt to be a soft spongy bearing surface for the metal cools before it has time to properly flow and set in the shell.

Soft bearing metals have a melting point of 625 to 750 deg. F. They should be heated at the place of pouring, and to about 10 deg. F. above the melting point of the metal. Block ends should be covered to prevent metal from flowing from the ends of the shell. Spindles or journals should be removed and trued up before replacing in new bearings of any type or kind. New poured plain bearings of soft metal should be reamed to the proper dimension of the shaft after it has been trued and spindles smoothed up.

Most bearing metal manufacturers have complete instructions in pamphlet form for the proper equipment, preparation, heating and pouring of soft metal alloys, and where necessary many of them will furnish the services of an engineer or service man to assist and instruct in the proper methods to use. Lubrication of plain bearings in an industrial plant is probably the costliest of all lubrication problems, most of which is chargeable to poor methods of handling when new bearings are poured.

Grooving

Figure 1 illustrates the proper grooving of plain bearings. Note that the pressure area is in the lower half of the bearing. Plain bearings should not be grooved in the pressure area, that is, the area which supports the pressure load. The pressure is usually so great in this area that the oil is wiped or forced from the spindle or journal into the groove which acts as a drain to carry the oil to the ends of the bearing where it is forced out.

Grooves cut in the pressure area tend to break the hydraulic pressure created by the rotation of the spindle which in turn reduces the support of the oil under the spindle in this area. Further, grooving in the pressure area reduces the supporting surface and increases wear on the remainder of the area.

Plain bearings should have ample clearance for the spindle and the supporting lubricant. This space allows free distribution of the lubricant to the entire bearing surface. Figure 2, A, B, and C shows exaggerated spindle clearances. In A the spindle is shown at rest on the bottom of the bearing. It will be seen that a slight film of oil is left in the clearance space, and that the spindle has pushed the oil out of the pressure area leaving metal to metal contact between the bearing and the spindle. This is the position of a spindle or journal before a machine is started up.

When the machine is started up, new oil begins to feed into the bearing in the top or open area. As the spindle begins to turn it tends to climb up the face of the bearing metal, still with partial metal to metal contact. In B, as the spindle increases in speed it draws the film of oil around its circumferential area as well as that of the bearing surface, and with the proper oil in the bearing, the force of the revolving spindle creates a pressure with the oil which brings the spindle into a near central position C in the bearing, leaving it surrounded and supported by a film of oil. At this point the starting effort, or torque falls off and the spindle is riding

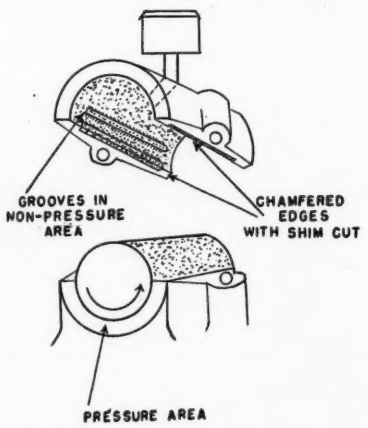


Fig. 1. Bearings should be properly grooved

Table I. Correct procedure of grooving plain bearings which are oil lubricated

BEARINGS	GROOVING
Small, one-piece, light pressure and load.	Not grooved or a small groove at point of introduction.
General service, two-piece bearings, high speeds, medium pressure or load.	Groove lengthwise in cap or non-pressure area. Do not cross or curve grooves. Chamfer joining edges. Taper chamfer edges.
Heavy service, slow speed, heavy pressure.	Groove lengthwise in non-pressure area. Chamfer joining edges, one groove in fore edge of pressure area.

friction free in the bearing.

In a two-piece bearing as shown in Fig. 1, the joining edges should be chamfered, with the outer edges of the chamfer tapered to prevent a scraping action on the oil as the spindle rotates. The chamfer grooves are usually cut about 1/8 in. deep by 1/4 in. wide, including the tapered edge.

They should be cut to a point about 3/8 in. from the ends of the bearing. Ends of the grooves should not be tapered, but left vertical to resist the pressure and flow of the oil from the ends of the grooves. Shims should be cut back in the chamfer area to prevent them scraping oil from the spindle at this point.

Drop and Flow

Two principal methods are employed in the lubrication of plain bearings. Drop feeds in which the amount of oil is controlled to the bearing, and gravity feeds in which the oil feeds by gravity in an uncontrolled and continual flow to the bearing. The latter method is rapidly being replaced in progressive plants by the drop feed or wick feed method. In the gravity flow method of feed, the oil being uncontrolled feeds rapidly to, and through, the bearing, resulting in serious oil loss. This is exaggerated if the bearing is loosely fit or worn to any extent.

In the ungrooved one-piece bearing, the oil is fed through a small opening in the bearing onto the spindle. It is carried in a circumferential direction downward or toward the pressure area. This does not allow the oil to spread in a longitudinal manner sufficient to properly lubricate the entire bearing surface thus resulting in rapid wear in the end areas. To remedy the condition, holes are drilled in the ends of the block and additional feeds made to enter the bearing, or, a small slot is cut in the top of the shell leading from the one entry point to the end sections. For grooving practice see Table I.

Table II. Properties and characteristics of oils in various types of service

Type of service	Gravity A.P.I.	Flash ° F.	Fire ° F.	Viscosity range s.s.u. at °F. 100	130	210	Pour ° F.	Characteristics and requirements
Electric motors, machine tools, high grade machinery	26-27	385 to 395	440 to 455	300	140	47 to 55	10	Mineral oils for oil lubricated anti-friction and close fit plain bearings, high film strength.
High pressure and hydraulic feeds	26-27	440 to 460	490 to 510	900	380	90	40	Heavy bodied oils. Great film tenacity required.
Centrifugal pumps, med. pressure hydraulic feeds, steam engines, compressors	26-27	390	445	315	140	48	10	Continuous use systems severe service, must resist emulsion, oxidation. Extreme purity and stability required.
Turbines, direct dr., low temp., geared and hydraulic	28 25	380 390	435 445	148 310	80 140	40 48	5-7 10	Circulating and ring oil systems must resist oxidation. Long life service requirements.
Diesels up to 148 hp. per cyl. scavenging-type	24	405	445	420	175	50	10	These characteristics do not apply to high speed or automotive, which require special engineering advice.
Non-scav.-circulating systems up to 360 hp. per cyl.	26-27	415	475	590	250	65	20	
Slow, heavy, loaded bearings	27-28	495	560	1500	610	115	35 to 45	Heavy bodied oils for adhesiveness, low pour resist washing in wet weather conditions.
Hot bearings, paper rolls, dryers, heavy press steel mill, headers	27	465	515	900	385	80	40	Heavy bodied oils. Great film strength, resist water and steam.
Smooth bearings, moderate speeds	22	385	435	385	164	50	14	Medium body oils, great persistence of film, compounded with vegetable oils for adherence of film.
High speeds, close fits moderate loads	24	390	440	385	168	52	14	Medium heavy bodied oils. General use machines, textile and paper mills.
Woodworking machines, grinders	27-29	350	400	135	75	40	14	Moderate speeds close fitted plain or ball bearings. Light body compounded for film strength.
Paper machines other wet conditions	20	380	430	700	310	75	70	Emulsifying type oils over load and shock bearings.

NOTE—These characteristics are general in purpose and range and are available through most oil companies for these specific services. For special applications and machines call in your oil company engineer who will make the proper recommendation for the condition.

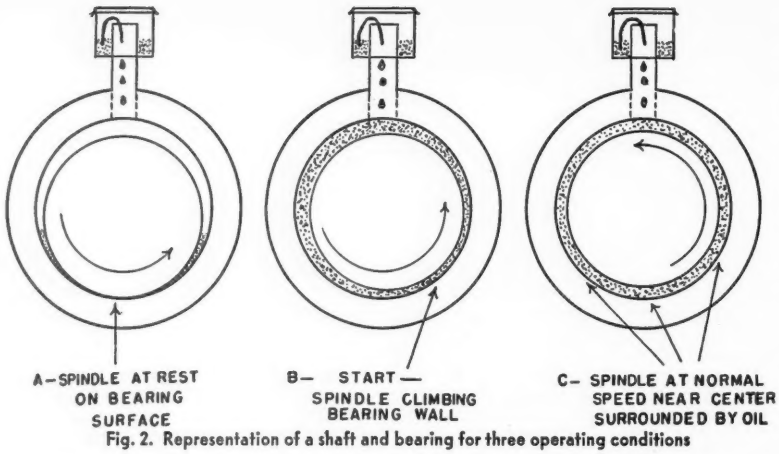

A—SPINDLE AT REST ON BEARING SURFACE
B— START — SPINDLE CLIMBING BEARING WALL
C— SPINDLE AT NORMAL SPEED NEAR CENTER SURROUNDED BY OIL

Fig. 2. Representation of a shaft and bearing for three operating conditions

Proper lubrication of plain bearings depends on the use of good practice in the following mechanical features: pouring, reaming and grooving of the bearing; the use of an oil best suited to the type of service and condition such as speed, pressure and temperature; and a controlled feed of oil.

The use of an oil best suited to the type of service and conditions, of course, covers a wide range. The type of service may vary from very slow speed journals to high speed textile spindles. The pressure may vary from a few pounds to several thousand pounds, temperature from minus 15 to plus 350 deg. F. Conditions may range from clean bearings and surroundings to dusty and dirty surroundings such as found in a paper mill or a wood working plant where the air is constantly filled with dust. Again it may be wet as bearings operating in water or steam or in a damp location. Operating service and conditions have a very decided influence in the selection of proper lubricants for bearings.

Types of bearings largely influence the selection of the proper lubricant for high grade machines. Most oil lubricated bearings come under one of the following methods of application; circulation, splash, ring oiling and bath oiled. Characteristics of lubricating oils vary with the intended type of service. In the above types of application the oil is used over and over again. In re-use service it must contain characteristics assuring long life and reliability. They must have uniformity, great film strength and great resistance to formation of sludge and emulsification.

High grade machines where application is by wick feed, drop feed or bottle oilers, require the same care in selecting the proper oil as that for the re-use system. These machines are equipped with high grade close fitting bearings often operating at high speeds and high temperatures and the method of application is no indication of the quality of oil required.

Grease lubricated plain bearings require the same mechanical considerations as oil lubricated bearings. Proper clearances, cleanliness, grooving, etc. Grease lubrication in bearings as well as guides, cams and eccentrics, means keeping a film of lubricant on the moving surfaces, reducing metal to metal contact and friction.

Grease contains lubricating value in the form of oils and fats. These are compounded in a base of high quality soaps. The quantity and grade of oil plus the quality of the soaps constitute the quality characteristic of most grease lubricants. The higher the content and quality of oil, plus the correct soap base, the higher the quality and lubricating value of the grease.

Operating conditions greatly influence the selection of greases for different types of service. Foremost in these conditions is temperature, that is, the temperature of the bearing in which the grease must operate. Temperatures ranging below 150 deg. F. are considered normal or low temperatures in any type of oil or grease lubricated bearing. Temperatures above 150

Table III. Some characteristics of greases and their uses by grades

Places where used	Desired consistency	Min. softening point ° F.	Sep. resistance	Range of oil Viscos. s.s.u. 100° F.	Oil pour point ° F.	Soap Base
Plain bearings, normal temp., moderate speeds	Smooth	160	Good	100-110	10-12	Lime
Cup grease for general purpose	Smooth	160	Good	90-100	10	Lime
Plain wet bearings	Smooth	180	Good	100-110	10-12	Lime
Pressure grease for use in guns on high speed plain or anti-friction bearings	Smooth	170	Very Good	825-850	10-12	Lime
Bearings in low temp. to ranges –35 deg. F.	Smooth	145	Good	90-100	–45	Lime
Wet condition water repellent insoluble	Smooth	180	Very Good	800-850	10-12	Lime Comp'd
Loose fitted, slow speed, exposed to weather	Smooth	140	Good	180-210	32	Lime
Very rough bearings, wet conditions	Smooth	160	Good	100-110	10-12	Lime-Graphite Comp'd
Heavy pressure plain and anti-friction, temp. to 350 deg. F.	Fibrous	240	Very Good	100-210*	32	Soda
Steel mill rolls, faral pipe	Special Engineering services required.					
Moderate speed, ball or roller light loads, gun or cup	Fibrous	290	Excellent	100-110	10-12	Soda
High speed, high temp.	Fibrous	350	Very Good	290-310	18-20	Soda
Ball bearings, roller.	Fibrous	390	Very Good	100-110	10-12	Soda

*Viscosity at 210 deg. F. All others taken at 100 deg. F.

deg. F. and up to 325 deg. F. are considered high temperature ranges. In some applications temperatures may range as high as 400 deg. F., but in such cases the conditions usually require, or have, special cooling facilities.

Principal factors in grease lubricants are structure and resistance to separation under various operating conditions and temperatures. Structure is controlled by the type of soap base contained in the grease and consistency by the compounding of the component parts. Lime soaps are used principally in the low temperature or general purpose greases, while the soda soap bases are used in the high temperature range greases. Lime soaps maintain their consistency satisfactory up to the range of 150 deg. F. in service, beyond which they break down in consistency and structure.

The amount of oil contained in a grease of course varies with the type of service and the quality of the grease. The so called general purpose greases contain oils of a viscosity and quality to perform satisfactory in low temperatures, low pressures and moderate speeds.

At the present time greases are being manufactured with softening ranges up to about 400 deg. F. New research developments are constantly being tested and it is expected that very soon, greases will be available with softening ranges up to 650 or 700 deg. F.

Ball and Roller Bearings

Ball and roller bearings are accurately ground and polished, both in the races and on the balls and rollers. Any abrasive action or condition within the bearing, whether it be metallic friction or foreign impurities such as dust or dirt, will immediately bring about a wear condition in the bearing, frequently resulting in a bad bearing in a short time. Ball and roller bearings are closed in and such a condition cannot be detected until it is too late to save the bearing. Cleanliness in the handling of lubricants, clean containers, guns, drums, oil cans and care to clean off fittings and oilers before filling will pay good returns in clean and free running bearings. This condition of course applies to all types of bearings and frictional surfaces.

Manufacturers of anti-friction bearings exercise extreme care in seeing that bearings are kept clean before delivery. They are wrapped in oil paper and delivered clean and rust free. Carelessness in handling after they are received frequently causes trouble. Leaving them unwrapped and exposed to dust and dirt, storing in a damp place, not properly cleaning bearings that have been opened and exposed to dirt before installation, all contribute to short bearing life.

Manufacturers of lubricants also exercise great caution in keeping lubricants clean. Drums and containers are washed and steamed before filling with new lubricants. Every precaution is taken to assure a clean lubricant being delivered to the user. Many lubricants are poured into containers at high temperatures, not only assuring cleanliness from dirt and dust, but also from bacteria in the lubricants.

INSPECTION AND MAINTENANCE SYSTEM

Part II. Strict adherence to a carefully planned system of inspection and maintenance in a power plant, such as is described here, is conducive to safety, reliability, economy and generally satisfactory operation. To be effective, a co-operative spirit on the part of all responsible individuals is essential. This is the second and last article of the series, the first was published in the March issue

By Y. C. Lu and T. Sun
Shanghai Power Co.
Shanghai, China

BRIEFLY stated, the objectives of a proper inspection and maintenance system are as follows:

(1) To keep up the traditional spirit of public utilities (in case of a central station) "to maintain continual supply of electricity" by preventing breakdown as much as practicable and by insuring available generating capacity with required reserve to meet seasonal demand.

(2) To secure minimum maintenance costs by keeping plant equipment in the best serviceable condition.

(3) To obtain general plant economy by arranging routine inspections to best advantage, taking into account the load demand, fuel and labor economy, rate of fouling, falling off in performance (for example, fouling of condenser tubes increases steam consumption), etc.

How much of these advantages can be realized will depend as much on the efficient operation of a proper system as on the careful planning of schedules. For a station with old equipment operated at its maximum capacity, unforeseen outages or breakdowns are liable to occur, but they can be held at a minimum by proper execution of a well planned schedule.

The co-operation of the operation and maintenance staff cannot be over-emphasized. The line of responsibility must be clearly defined before hearty co-operation may be obtained.

Organization

In case of the plant being situated far distant from the manufacturers of equipment, a station may find it necessary to maintain a regular maintenance force subdivided into mechanical and electrical, and each department will take charge of all maintenance work, including overhaul of equipment at regular intervals and minor irregular repairs. Each of the maintenance departments will form a separate service department by itself. The system does not provide special inspectors. Inspection jobs are included in a "General Inspection and Maintenance Schedule." Inspection and maintenance work by the same group of personnel has proved to be convenient and efficient. Friction is avoided. The line of responsibility is more clearly defined.

Both maintenance department heads are responsible to the Station Superintendent who maintains a Bureau of Inspection and

Maintenance (BIM) whose functions are briefly as follows:

1. To prepare annual inspection and maintenance schedules.
2. To notify the maintenance departments ahead of time of each item of maintenance work according to schedule and issue inspection report forms.
3. To check scheduled inspection reports that have been returned and file reports in folders making up the "History File."
4. To keep service records of major and auxiliary equipment (in separate service books) and to assemble data as to operating hours since last overhaul of principal units.
5. To utilize information in history file and service books to revise the inspection and maintenance schedule.

Besides, BIM will keep the necessary service records for important experimental work such as trials on new materials and to secure information from engineers in charge of experiments as to records to be kept. BIM will also make a comparative study of different materials for certain machine parts which are subject to wear or deterioration, recording the cost against the useful life.

Co-ordination

There are two terms that the writers wish to recommend to the power plant operators: "In Commission (i/c) and out of commission (o/c)." By "In Commission" is meant a piece of equipment whether it be a turbine, a boiler, a pump, a transformer or a switch, which has been worked on, thoroughly inspected and considered to be fit for operation by the maintenance department. The moment the equipment is handed over to the operating staff for continuous operation, the equipment is i/c. Similarly, a piece of equipment taken off load for inspection, whether for any suspected defects or for any predetermined overhaul or cleaning, is said to be o/c. The time o/c begins is at the moment when the equipment is taken off load by the operating men and handed over to the maintenance staff.

In collaboration with maintenance department, shift engineers of operation department will report on the regular form (Defect Report, Fig. 1) to the operating engineer any equipment not in proper working conditions as in case of breakdown or development (actual or suspected) of a defective condition. The operating engineer will approve and forward the report to the maintenance department concerned. Upon receipt of such defect report, inspection and repairs will be made by the maintenance department in accordance with the urgency of the case and a report submitted on inspection report form by the engineer in charge of the work.

For any scheduled or defect inspection (emergency repairs excepted) an "Outage Requisition" (Fig. 2) should be sent by the maintenance department to the operating engineer requesting the outage of any particular piece of equipment for specified work at the required time. The operating engineer will make the necessary arrangement for such outage and inform both maintenance departments (electrical and mechanical) the time available for maintenance. In case the outage is requested by mechanical maintenance department the same time may be utilized by electrical maintenance department to do whatever electrical work that is found necessary. For emergency repairs, shift engineers will record the actual time o/c and i/c on station log books.

The operating engineer will summarize time and reason for all outages during the previous day into a "Daily Outage Report" (Fig. 3) which will be sent to BIM.

Before the close of the year, maintenance department heads will revise the inspection manual which covers detailed instructions

NAME OF COMPANY
NAME OF STATION
MAINTENANCE DEPT. (MECH. OR ELEC.)

OUTAGE REQUISITION

NO.____ DATE_____

TO OPERATING ENGINEER

PLEASE ARRANGE o/c FOR

DATE DESIRED	EST. REQ'D TIME	DATE & TIME o/c	DATE & TIME i/c

WORK TO BE DONE:

REQUISIONED BY _____ APPROVED BY _____

DATE_____
TO STATION CHARGE ENGINEER
OPERATING ENGR._____

DATE_____
TO*_____MAINTENANCE DEPT.
OPERATING ENGR._____

(* IF REQUISITION IS MADE BY MECH. MAINT. DEPT. DUPLICATE COPY TO BE SENT TO ELEC. MAINT. DEPT., AND VICE VERSA.)

NO.____ DATE_____

TO OPERATING ENGR.

EQUIPMENT_____
DATE & TIME i/c
_____

WORK DONE

ATTENDED BY_____

(THIS SLIP TO BE FILLED IN BY THE ONE WHO REQUISIONED FOR OUTAGE AND ATTENDED THE JOB)

Fig. 2. Outage Requisition

NAME OF COMPANY
NAME OF STATION
OPERATING DEPT.

DEFECT REPORT

NO._____ DATE_____

EQUIPMENT	
DEFECT OBSERVED	
AVAILABLE FOR REPAIRS	DATE _____ TIME _____
REPAIRS MADE	

NUMBER OF WORKMEN EMPLOYED		OPERATION DEPT.	REPORTED BY
			APPROVED BY
		MAINTENANCE DEPT.	ATTENDED BY
			APPROVED BY

NO._____ DATE_____

TIME	
WORK STARTED	WORK FINISHED

WORK DONE:

ATTENDED BY	
MAINT. DEPT.	
OPERATING ENGR.	
FILED BY	

(THIS SLIP TO BE RETURNED BY THE MAINTENANCE DEPT. TO THE OPERATING ENGR. & THEN PASSED TO THE ONE WHO REPORTED THE DEFECT.)

Fig. 1. Defect Report

of the work to be done for various kinds of inspection for each type of equipment. BIM will prepare or revise inspection report forms from date in manuals, also prepare general inspection and maintenance schedule (Fig. 4) for the succeeding year. The general schedule is in reality a summary of respective schedules, boilers, turbines, switchgears and other major auxiliaries, designed to show scheduled inspection due for respective months of the year.

Between the twentieth and twenty-fifth of each month BIM will list equipment due for overhaul or inspection in the following month and forward to maintenance departments for attention.

Based on this monthly work schedule, maintenance heads will prepare a "Weekly Maintenance Program" showing predicted inspections for the coming year. These programs, after being approved by the station superintendent, will be issued every weekend for arranging to shut down the required equipment and making necessary preparations.

Every Saturday morning BIM will issue according to the "Weekly Programs" blank inspection report forms which will serve as work orders for units to be taken out for scheduled inspections. Additional report forms will be issued for unscheduled outages or those not included in "'Weekly Programs" as soon as BIM receives the "Daily Outage Report" from the operating department.

Whatever work is done will be shown on the inspection report form which will be signed by the inspectors and returned to department heads and then to BIM. Measurements, clearances, etc., will be recorded on separate sheets when necessary. The inspection

GENERAL INSPECTION & MAINTENANCE SCHEDULE
FOR THE YEAR 1940

EQUIPMENT SYMBOL	OPERATING HR. ALLOWABLE	OPERATING HR. ACTUAL	TYPE AND APPROXIMATE DATE OF INSPECTION — JAN. 10 20	FEB. 10 20	MAR. 10 20	APRIL 10 20	MAY 10 20	JUNE 10 20	JULY 10 20	AUG. 10 20	SEPT. 10 20	OCT. 10 20	NOV. 10 20	DEC. 10 20
B 21	RI 2000 GO 40000	GO 14,600	(RI) O/C 1/2/40 I/C 1/8/40			(GO)	O/C 6/15/40 I/C 7/8/40		OVERHAUL DEMAND	POSTPONED RI	ACCOUNT	HEAVY	RI	
B 20	"	GO 13,400	O/C 2/6/40 I/C 2/24/40	(GO)			O/C 6/3/40 I/C 5/15/40	(RI)				RI		
B 19	"		O/C 1/28/40 I/C 1/31/40	(RI)	O/C 4/20/40 I/C 4/27/40	(RI)					GO			RI
ETC.														
T 13	GO 14,000													
T 12	"	GO 15,200				(GO)	O/C 6/10/40 I/C 7/5/40		OVERHAUL AND LATE ARRIVAL	POSTPONED OF ORDERED	ACCOUNT PARTS	HEAVY	DEMAND	
		ETC.												

NOTE: RI – ROUTINE INSPECTION & SOOT CLEANING
GO- GENERAL OVERHAULING

Fig. 4. General Inspection and Maintenance Schedule

manual should be followed closely both in performing and reporting all inspections. Whenever an inspector finds the equipment in bad order he should report to the department head who will specify what repairs are to be made. All repairs found necessary will be made at the time of inspection and described fully in the report so as to enable the department head to decide whether or not the next scheduled inspection should be revised, then notify BIM with particulars.

Upon receipt of the completed inspection report by BIM a circle will be drawn around the proper symbol on the general schedule (Fig. 4). If an inspection cannot be made according to schedule the circumstances should be reported to BIM. Deferred inspections will be posted in the proper monthly work schedude and be given preference that month. When inspection is made behind or ahead of schedule, proper marks will be made as shown in Fig. 4. This will show the status of the schedule at all times.

Inspections made at shorter intervals than one month (hourly, daily, weekly, etc.) will be made by the operating staff or by men assigned specially to the making of "Running Inspection and Repairs." Such inspection falling under the duties of operators will not be considered in connection with this system. Reports for such running inspection, however, should be sent to BIM for checking and filing.

Any important and special jobs such as revamping of main and auxiliary units, experimental work on new materials, inspections after station service interruptions, and the like, will be reported to the station superintendent by the department in charge of work with a copy sent to BIM.

Keeping track of the current condition of equipment as revealed by scheduled inspections and historical data recorded by BIM, will facilitate the forecast of some specific repairs, such as turbine reblading, change of pump and fan impellers, etc. Machine parts will be ordered at the proper time. A good plant inspection and maintenance system is undoubtedly a tremendous help to a correct budgeting of plant expenses.

But the co-operative spirit is essential. Once a schedule is set up, all efforts in the station should be directed towards its fulfillment. It is better to specify beforehand the time for a certain work than to blame anybody for delay when the men working on it do not know what they are expected to do. There is no reason why the principles of scientific management that have been utilized so successfully in manufacturing plants, should not be applied to the inspection and repair jobs in power generating stations.

NAME OF COMPANY
NAME OF STATION
OPERATING DEPT.

DAILY OUTAGE REPORT

TO BIM

24 HR. ENDING 8 A.M. ---------- 19----

BOILER	TURBINE	CIR. WATER PUMP	BOILER FEED PUMP	FEEDERS	OTHER EQUIPMENT	TIME %	TIME %	% FOR

NOTE: ACTUAL OPERATING TIME TAKEN FROM DAILY LOG SHEET

OPERATING ENGR. ----------

Fig. 3. Daily Outage Report

EQUIVALENT SURFACE AREAS

Part II. Application of a new method of comparing boiler performance and further interpretation of the E. S. A. Diagrams[1]

By G. CAMPBELL KOHLAR

SEVERAL "thumb-nail" E.S.A. diagrams are shown in Fig. 2. Figure 2A shows the effect of varying the load on a boiler. What this diagram does, in effect, is to show the comparison between two boilers, each having an input of 500,000,000 B.t.u. per hr., but one of which has considerably more heating surface than the other. It is obvious that if two boilers each have the same input and each absorbs substantially the same amount of heat, the boiler with the lesser heating surface is working harder than the other; that is, it is operating at a higher rating. This introduces the first great advantage of an E. S. A. diagram; it brings a rate-of-input factor into the picture. Secondly, from the manner in which the E. S. A. is determined, every point on a vertical line, such as AB, has the same B.t.u. available per sq. ft. of heating surface up to that point. When it is recalled that E. S. A.

$$= 500{,}000{,}000 \times \frac{\text{Heating Surface}}{\text{B.t.u. Available}}$$

or

$$500{,}000{,}000 \div \frac{\text{B.t.u. Available}}{\text{Heating Surface}}$$

it is quite plain that this must be so.

But Point "x", although it has the same E. S. A. as Point "y", lies above it, thus indicating that a larger percentage of the available heat has been absorbed by the same E. S. A. under the operating conditions of the upper diagram. This brings out the fact that while the E. S. A. diagram always shows *what* happens in a boiler, it does not always tell *why* things happen. To understand the "why," it is sometimes necessary to go back to the orthodox heat balance tests, or to the physical arrangement of the heating surface.

Closely spaced tubes absorb more heat than tubes on wide spacings, clean surfaces are superior to fouled surfaces, and varying quantities of excess air create varying adiabatic temperatures which in turn affect the quantity of heat absorbed. Adiabatic temperature is very important in radiant heat transfer. It is the temperature which would be attained when burning fuel with a given quantity of excess air if no transfer of heat took place between the flame and its surroundings. It is sometimes called the "theoretical flame temperature." The more air that is used to burn a pound of any fuel, the greater the weight of gas which will result from the combustion; but since the fuel has a definite calorific value, the more the gas that is formed the less the heat that is available for each pound of gas, and the lower the adiabatic temperature.

Figure 2B shows the effect of varying the total air while maintaining a constant load. The lower total air gives a higher adiabatic temperature and increased heat absorption. Note that the points e, f, and g, represents the same point in the boiler, but that each has a different value of E. S. A. Decreasing the total air has the effect of increasing the equivalent surface, or raising the efficiency of a boiler. This is important. When comparing different boilers, especially from an operating point of view, it is desirable to reduce all E. S. A. diagrams to the same total air at the furnace outlet, thereby eliminating any advantage which one boiler might gain from more favorable operating conditions.

In Fig. 2C and 2D, another advantage of this method of boiler comparison is illustrated. By the use of distinctive types of lines, it is easy to portray clearly the exact part that each individual section plays in the performance of the unit as a whole. The vertical scale gives the percent of the total heat available that any section absorbs, while the slope of the line connecting the starting and the end points of the section shows the rate at which the section is absorbing heat. From Fig. 2D it will be noted that "u" units is the percent of heat absorbed in the superheater, and that u/v is the rate at which the superheater is absorbing heat. The following

[1]Part I appeared on page 55 of the March 1941 issue of Power Plant Engineering.

Table IIA. Data used for calculating the three E. S. A. Diagrams shown by Fig. 3. B-1 and B-2 are for pulverized coal and C-1 for oil firing

TABLE IIA

1. Test			B-1		
2. Rated steam output, lb./hr.			100,000		
3. Steam output on test, lb./hr.			105,900		
4. Section of unit	Furnace	First Bank	Sup'htr	2 & 3 Bank	Air Htr.
5. Total input from fuel, Million B.t.u./hr.	132.3				
6. Total preheat in air above 80 deg. F., Million B.t.u./hr.	10.6				
7. Total losses, latent heat and Carbon, Million B.t.u./hr.	7.4				
8. Total heat available above 80 deg. F., Million B.t.u./hr.	135.5				
9. Gas temperature leaving section, deg. F.	2,280	1,900	1,268	647	398
10. Heat available in gas entering, Million B.t.u./hr.	135.5	79.2	64.7	40.9	24.7
11. Heat absorbed: Individual section, Million B.t.u./hr.	56.3	14.5	23.8	16.2	10.6
12. Heat absorbed: Cumulative, Million B.t.u./hr.	56.3	70.8	94.6	110.8	121.4
13. Heat absorbed: Individual section ÷ Item 8, %	41.6	10.7	17.5	11.9	7.8
14. Heat absorbed: Cumulative ÷ Item 8, %	41.6	52.3	69.8	81.7	89.5
15. Heat absorption: Individual section, B.t.u./sq. ft./hr.	33,200	13,900	10,850	1,995	1,026
16. Heat absorption: Cumulative, B.t.u./sq. ft./hr.	33,200	25,900	19,200	8,480	5,190
17. Surfaces: Individual section, sq. ft.	1,695	1,043	2,197	8,118	10,320
18. Surfaces: Cumulative, sq. ft.	1,695	2,739	4,935	13,053	23,373
19. E. S. A., (500 × 10^6 ÷ Item 8) × Item 18, sq. ft.	6,250	10,100	18,170	48,200	86,200

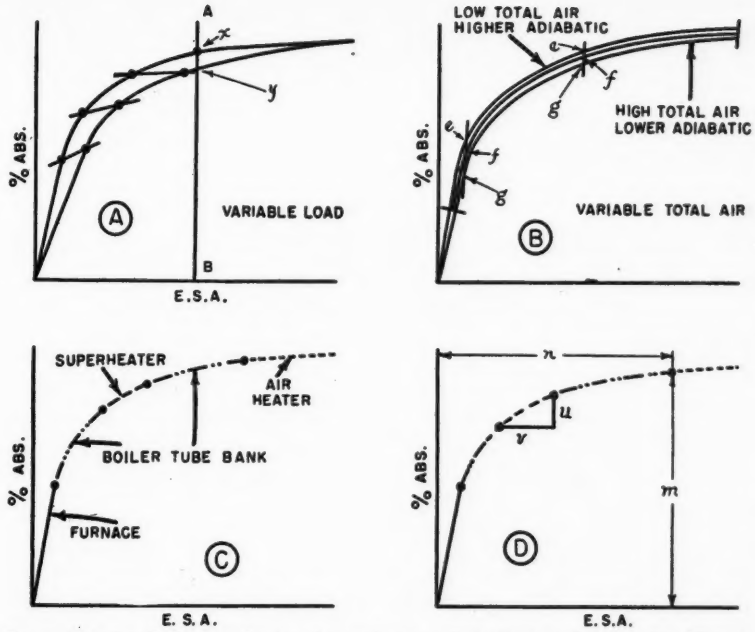


Fig. 2. Thumb-nail sketches showing the application of the E. S. A. Diagram for different conditions

simple equations demonstrate this principle:

$$u = \frac{\text{Heat Absorbed in the Superheater}}{\text{Total Heat Available}};$$

$$v = \text{E. S. A.} = 500{,}000{,}000 \times \frac{\text{Heating Surface of Superheater}}{\text{Total Heat Available}}$$

$$\frac{u}{v} = \frac{\text{Heat Absorbed}}{\text{Heating Surface}} \times \text{a Constant}$$

and the units are B.t.u./sq. ft.-hr.

Referring to Table I of Part 1,

$$u = \frac{31.0 \times 10^6}{155.0 \times 10^6},$$

$$v = 500 \times 10^6 \times \frac{2500}{155.0 \times 10^6}$$

Just as u/v represents the rate at which the superheater is absorbing heat, so m/n represents the rate at which the entire unit up to the boiler outlet is absorbing heat. Thus a steep line—like the furnace line in the sketches—represents a rapid rate of heat absorption; whereas a flat line—like the air heater line—represents a much slower rate of absorption.

Figure 3, which shows three E. S. A. diagrams plotted from the test data of Table II, demonstrates how the foregoing principles may be applied to actual boilers. The B Series, 1 and 2, are tests of a pulverized coal fired boiler at two different rates, while Test C was made on an oil fired boiler of the same type although somewhat larger. Comparing B-1 and B-2, it is evident how the rate-of-input factor applies. It will be seen at a glance that the steam output of B-1 is the higher since the E. S. A. is much less than B-2.

Significance of Slope

Slopes of the furnace, first boiler bank, and superheater lines are steeper on the high rating test, indicating that these sections absorb heat at a faster rate with increased output, and that they are more responsive to increased heat input because of higher temperatures and greater mass-flow through the sections. However, corresponding points in the unit, such as the furnace outlet and the superheater outlet, show higher percentages of heat absorbed for the lower load. This would be expected because of the higher efficiency at reduced ratings. The boiler is not working so hard and has time to do a better job.

Test C-1 shows this boiler to be operating at a rating even higher than that of B-1. Notice the furnace line. Not only has it a steeper slope, but also it indicates a higher percentage of heat absorbed at the furnace outlet. In this case, the furnace walls are much cleaner than the slag covered walls of the B Series and more responsive to heat absorption. Beyond the superheater the curves are substantially parallel, which means that the rate of heat transfer is about the same in the rear bank of tubes and the air heater of both boilers.

The type of fuel fired apparently does not have as marked an effect on the cleanliness of the sections of the unit after the super-

Table III. Data used for calculating the E. S. A. Diagrams of Fig. 4

Length of Side—Ft.	10	20
Volume—Cu. Ft.	1,000	2,000
Surface—Sq. Ft.	500	2,000
Input—B.t.u. per Cu. Ft.	40,000	40,000
Total B.t.u.	40×10^6	320×10^6
Furnace Temp.—Deg. F.	1,940	2,330
Adiabatic Temp.—Deg. F.	3,600	3,600
Heat Absorbed—B.t.u.	20.5×10^6	125.9×10^6
Heat Absorbed—% of total	51.2	39.3
E. S. A.	6250	3125

Table IIB. Continuation of Table IIA with data for curves B-2 and C-1 of Fig. 3

TABLE IIB

1.			B-2					C-1		
2.			100,000					160,000		
3.			83,300					156,000		
4.	Furnace	1st Bk.	S.H.	2 & 3 Bk.	Air Htr.	Furnace	1st Bk.	S. H.	2 & 3 Bk.	Air Htr.
5.	102.0					204.0				
6.	7.3					17.4				
7.	5.7					13.4				
8.	103.6					208.0				
9.	2,285	1,825	1,146	604	378	2,175	1,725	1,510	707	409
10.	103.6	59.1	46.03	27.13	17.40	208.0	117.5	90.5	78.2	37.7
11.	44.5	13.07	18.90	9.73	7.30	90.5	27.0	12.3	40.5	17.4
12.	44.5	57.57	76.47	86.20	93.50	90.5	117.5	129.8	170.3	187.7
13.	43.0	12.6	18.2	9.4	7.1	43.5	13.0	5.9	19.5	8.4
14.	43.0	55.6	73.8	83.2	90.3	43.5	56.5	62.4	81.9	90.3
15.	26,200	12,500	8,610	1,198	707	55,400	13,500	17,850	3,990	1,054
16.	26,200	21,000	15,500	6,600	4,000	55,400	32,300	30,000	11,780	6,070
17.	1,695	1,043	2,197	8,118	10,320	1,633	2,000	690	10,142	16,500
18.	1,695	2,738	4,935	13,053	23,373	1,633	3,633	4,323	14,465	30,965
19.	8,190	13,200	23,800	63,000	112,600	3,920	8,740	10,390	34,780	74,400

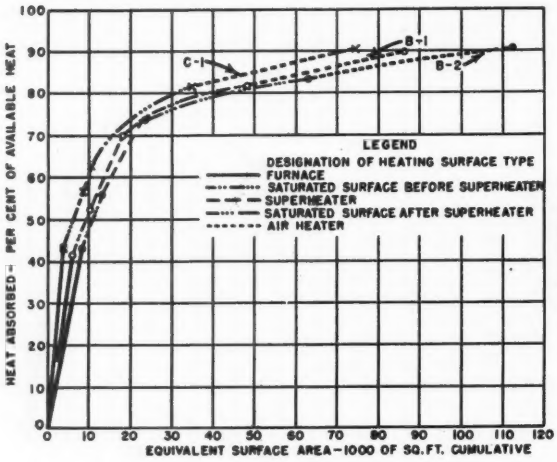


Fig. 3. E. S. A. Diagrams for three different units calculated from the data of Table II. B-1 and B-2 are for pulverized coal, C-1 for an oil fired unit

heater as it has on those preceding and including it. The superheater line is shorter and steeper for oil firing. The steepness has already been accounted for by the cleanliness factor, and from the shortness of the line one would be led to believe that the superheater is much smaller and the total steam temperature lower in the oil fired unit. Such is actually the case (see Item 17, Table II).

One further point. The author has tried to show in several previous articles that B.t.u. per cubic foot of furnace volume or B.t.u. per foot of furnace width were very disadvantageous and misleading terms. Nothing could make this more apparent than an E. S. A. diagram. Let us suppose two quite theoretical furnaces, each cubical, fired with the same fuel and total air, and the same input in B.t.u. per cubic foot of volume. One of these furnaces has a side 10 ft. long, and the other 20 ft. Assume these furnaces both to be completely water-cooled on five sides. Table III gives the necessary facts.

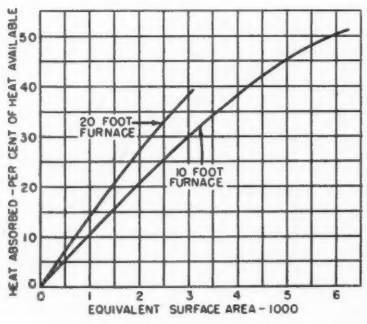


Fig. 4. Comparison of two furnaces to show the effect of furnace width on performance. Data given in Table III

We see from Fig. 4, that the larger furnace is being pushed much harder, and that for any given value of E. S. A. the per cent of heat absorbed is higher. But the smaller furnace as a whole has absorbed a greater proportion of the total heat available, and we would expect the temperature of the gases leaving the small furnace to be relatively low in virtue of this. The performances of these two furnaces differ widely, in spite of the fact that each has the same B.t.u. per cubic foot of volume available.

This helps to explain why often a fuel which can be burned successfully in one furnace, gives considerable trouble when burned under what appears to be the same conditions in a similar, but larger furnace. If these conditions obtained in two pulverized coal fired furnaces, for example, a coal having an ash fusion temperature of 2100 deg. F. would burn without difficulty in the smaller furnace, but it would be impossible to burn it in the large furnace and still remove the ash in a dry state. If a similar table and diagram be constructed on the basis of equal inputs per front foot, an exactly opposite set of results will be obtained. The larger furnace in this case will be found to be operating at a lower rating than the smaller.

TROUBLE MAKERS IN LUBRICATING OIL

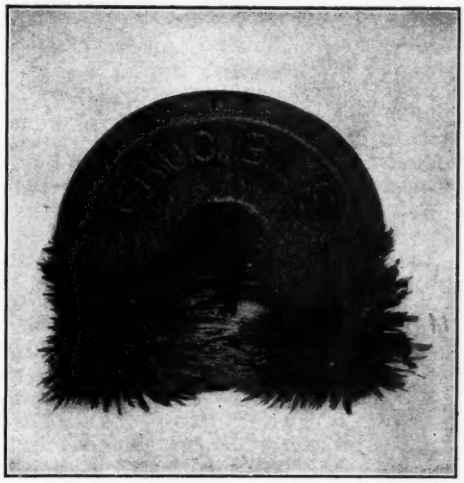
By R. A. TREFETHEN
S. G. Frantz Co., Inc.
New York, N. Y.

MORE AND MORE operating engineers are realizing how important it is to keep lubricating oil systems free from fine iron particles which constantly find their way into the oil in spite of every precaution, and these engineers are giving serious attention to safeguarding costly equipment from this ever present menace.

Iron particles get into the system from wear of journals, gears, etc., from rust and dust passing the air filter, and in the case of internal combustion engines, from cylinder and ring wear. They are mixed with the oil and remain in it until removed, usually until the oil is changed. As the oil circulates, these pernicious fine particles are carried around the circuit and are fed again and again between the lubricated surfaces where they act as an abrasive and accelerate wear at an ever increasing rate.

Every engineer should bear in mind that particles up to 0.0025 in. in size, which may not be removed by ordinary strainers or edge-type filters, can break the oil film and bridge the bearing clearances. Their removal assures better protection to bearings and reduced down-time, with its consequent loss of production. It also greatly retards chemical degradation of the oil in internal combustion engines, and thus holds the lube oil nearer its original condition with maximum lubricating qualities.

Recent careful laboratory tests have shown the important part played by microscopic iron particles in promoting chemical breakdown of the oil, with increase of acidity. These tests, made by an independent laboratory (Technical Service Bureau, Inc., Chicago, Ill.) on a small internal combustion engine showed that the use of a magnetic sep-



Fine iron particles taken from the lubricating oil system of a new 300 hp. Diesel during a run-in test

arator in the lube oil system reduced the following items to the extent indicated: Total oxidation, 93.7 per cent; free acidity, 68.6 per cent; ash, 81.8 per cent; iron, 86 per cent.

When the new type magnetic separator is used, iron particles as microscopically fine as one micron (1/25,000 in diam.) are caught and held on the magnetized screens. Particles of substances (including lead) not ordinarily thought of as magnetic have been found in the material collected, probably due to a tendency for these impurities to stick to the iron particles and be removed with them. Oil additives or compounding agents are not removed.

The photograph shows some of the fine iron particles removed from the lube oil system of a 300 hp. Diesel during the run-in on the test stand. The particles were cleaned off the magnetized screens of the separator after the run, and then picked up on the hand magnet for further inspection and study in the laboratory.

CALCULATING HEAT VALUE FOR COAL

Conversion of coal data from one basis to another and estimates of heating value from either ultimate or proximate analysis is not difficult but the type of coal must be carefully considered because formulas are accurate only for limited application

By J. R. Darnell

SOME TWENTY years' experience in fuel engineering has demonstrated to my satisfaction that few if any formulas for calculating the heat value of coal from analysis are correct except for a small range of values. There are many variables, among them sulphur which increases the value of the volatile matter and upsets calculations for ultimate carbon.

If the so-called proximate analysis is the only information available, in order to determine the heat value of the coal in B.t.u. per pound, an ultimate analysis of the coal must be first calculated. Having calculated the ultimate analysis, the heat value of the coal then may be calculated with a fair degree of accuracy by Dulong's formula:

B.t.u. per lb.

$$= 14{,}550\ C^1 + 62{,}000\ (H^1 - O^1/8) + 4050\ S^1$$

where C^1, H^1, O^1 and S^1 are fractional parts (i. e. percentages ÷ 100) by weight of carbon, hydrogen, oxygen and sulphur respectively, AS FIRED. This formula, however, does not apply to high oxygen fuels such as lignites, subbituminous coals and wood refuse.

An ultimate analysis may be calculated from the proximate analysis by the following formula:

For ultimate hydrogen,

$$H = V\ [7.35 \div (V + 10.0) - 0.013]$$

For ultimate carbon,

$$C = F + 0.9\ (V - K)$$

where K = 10 for fine sizes of anthracite; 14 for bituminous coals; and 18 for lignites.

For ultimate nitrogen,

$$N = 0.07\ V \text{ for fine sizes of anthracite,}$$

or,

$$= 2.10 - .012\ V \text{ for bituminous coals}$$

where, H, C, and N are per cent by weight respectively of hydrogen, carbon and nitrogen in one pound of coal, referred to a MOISTURE AND ASH FREE BASIS. F and V are the per cent by weight respectively of the fixed carbon and the volatile matter given in the proximate analysis, referred to A MOISTURE AND ASH FREE BASIS. Sulphur in the coal increases the value of V and hence the calculated value of C in the ultimate analysis, in some cases, may be too high by practically the sulphur content of the coal, referred to a moisture and ash free basis.

Table I shows both proximate and ultimate analysis of a typical coal from the Pittsburgh district.

Changing the above values from an as fired to a moisture and ash free basis is simple for the F.V., V.M., C, N and S for the former values need only be multiplied by $100 \div [100 - (M + A)]$. The H and O values are more complicated for they must be corrected for the moisture values on the basis of a ratio of 1 to 8. The calculation for these two are

$$H = \left(5.2 - \frac{2.51}{9}\right) \frac{100}{2.51 + 10.39} = 5.64$$

$$O = \left(7.6 - \frac{2.51 \times 8}{9}\right) \frac{100}{2.51 + 10.39}$$

$$= 6.14$$

Table I. Analysis in per cent in a Typical Pittsburgh District Coal with a B.t.u. value as fired 13,365.

	AS FIRED	
	PROXIMATE	ULTIMATE
Fixed carbon[1]	56.82	C^1 74.0
Volatile matter[1]	30.28	H^1 5.2
Moisture[1]	2.51	O^1 7.6
Ash[1]	10.39	N^1 1.4
		S^1 10.4
	100.00	Ash^1 10.4
Sulphur	1.4	
		100.0
	ON A MOISTURE AND ASH FREE BASIS	
Fixed carbon	65.20	C 85.00
Volatile matter	34.80	H 5.64
		O 6.14
	100.00	N 1.61
		S 1.61
		100.00

Now, referring to the formula for calculating ultimate analysis from proximate, using the above values we have, in per cent on an ash and moisture free basis

$$H = 34.8\left(\frac{7.35}{34.8 + 10.0} - 0.013\right) = 5.7$$

$$C = 65.2 + 0.9\ (34.8 - 14.0) = 83.92$$
$$N = 2.10 - (0.012 \times 34.8) = 1.68$$

The above calculated values are very close to those actually shown by the laboratory results of Table I.

Table II. Approximate Relation Between (A) Volatile Matter, and (B) Hydrogen, Both Figured as Percentages on the Moisture-and-Ash-Free Basis. This table applies to coals of 12,000 to 15,000 B.t.u. per lb. on the moisture-and-ash-free basis.

A	B	A	B	A	B
25.0	4.30	37.0	5.03	49.0	5.51
25.5	4.33	37.5	5.05	49.5	5.52
26.0	4.36	38.0	5.07	50.0	5.54
26.5	4.40	38.5	5.10	50.5	5.56
27.0	4.43	39.0	5.13	51.0	5.57
27.5	4.47	39.5	5.15	51.5	5.58
28.0	4.50	40.0	5.17	52.0	5.60
28.5	4.53	40.5	5.20	52.5	5.61
29.0	4.56	41.0	5.22	53.0	5.62
29.5	4.60	41.5	5.24	53.5	5.63
30.0	4.63	42.0	5.26	54.0	5.64
30.5	4.65	42.5	5.28	54.5	5.65
31.0	4.68	43.0	5.30	55.0	5.66
31.5	4.72	43.5	5.32	55.5	5.67
32.0	4.75	44.0	5.34	56.0	5.67
32.5	4.78	44.5	5.36	56.5	5.68
33.0	4.81	45.0	5.38	57.0	5.68
33.5	4.84	45.5	5.40	57.5	5.69
34.0	4.87	46.0	5.41	58.0	5.69
34.5	4.90	46.5	5.42	58.5	5.69
35.0	4.93	47.0	5.44	59.0	5.70
35.5	4.96	47.5	5.46	59.5	5.70
36.0	4.98	48.0	5.48	60.0	5.71
36.5	5.00	48.5	5.50		

Compare the calculated value of 5.7 per cent hydrogen with 5.64 per cent; also compare the value of 83.92 per cent carbon as calculated with 85 per cent and the calculated nitrogen value of 1.68 per cent with 1.61 per cent. Complete calculated values on a moisture and ash free basis are, therefore:

H. ...	5.70
C. ...	83.92
N. ...	1.68
S. ...	1.61 (not calculated)
O. ...	7.09 (by difference)
	100.00

Converting these values to the "As Fired" basis we have: $C^1 = 73$ per cent; $H^1 = 5.25$ per cent; $S^1 = 1.4$ per cent; $O^1 = 8.42$ per cent. Using Dulong's formula with the above values, the heat value is:

$$(14{,}550 \times 0.73) + 62{,}000\ (0.0525 - 0.0105) + (4050 \times .014) = 13{,}257 \text{ B.t.u.}$$

Compare this heat value with that of 13,365 B.t.u. as actually determined by the calorimeter.

High oxygen coals with high moisture such as those found in the midwest, lignites and sub-bituminous coals cannot be used with the foregoing formulas. For coals of this character, having heat values of 9500 to 13,000 B.t.u. per lb. on a moisture free basis, or 12,000 to 15,000 B.t.u. per lb. moisture and ash free basis, a different method of calculation must be used to determine the heat value.

Technical paper 197 of the United States Bureau of Mines gives a curve showing the relationship between volatile matter and ultimate hydrogen. Table II was compiled from this curve.

Table III was developed as a result of a study of a large number of samples of coals found in the midwest, particularly from Illinois, Indiana and Kentucky. This table shows the relationship between the sum of the volatile matter and fixed carbon and the amount of ultimate carbon found in the sample.

If the amount of the sulphur in the coal has been separately determined, by the use of these two tables, one can first compute the ultimate hydrogen and carbon in a coal sample from a proximate analysis and then calculate the heat value by Dulong's formula. As an example of the use of these tables, take an Illinois coal having the following proximate analysis as fired: moisture, 13.54; volatile matter, 35.69; fixed carbon, 40.03; ash, 10.74. Sulphur (separate analysis) 4.03 per cent.

Computing the volatile matter on a moisture and ash free basis, we obtain a figure of 47.2 per cent. Referring to Table II the ultimate hydrogen for this value of volatile matter is found to be 5.45 per cent (moisture and ash free). Figuring this back to "as fired" gives a value of 5.63 per cent.

The ultimate carbon is found by reference to Table III. The sum of the volatile matter and fixed carbon (moisture free) in the above sample is 87.8 per cent. From Table III, starting in the left hand column at 87 and going across to the column headed 0.8, a value of 68.63 per cent ultimate carbon is found (moisture free). The ultimate carbon as received then will be $68.33 \times 0.8646 = 59.0$ per cent.

Since the percentage of nitrogen in Illinois coals averages from 1.1 to 1.3 (moisture free) a value of about 1.2 per cent may be considered as fairly representative. In the above sample the value, as fired, would then be 1.07 per cent.

The calculated ultimate analysis, as fired would then be:

carbon	59.00 per cent (calculated)
hydrogen	5.63 per cent (calculated)
nitrogen	1.07 per cent (estimated)
sulphur	4.03 per cent (actual)
ash	10.74 per cent (actual)
oxygen	19.53 per cent (by difference)
Total	100.00 per cent

Table III. Approximate relation between percentage of ultimate carbon and the sum of the percentages of volatile matter (V.) and fixed carbon (F.C.), all on a moisture free basis, for coals of 9500 to 13,000 B.t.u. (moisture free).

V. + F.C.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
65	50.26	50.33	50.40	50.47	50.55	50.63	50.69	50.76	50.83	50.91
66	50.98	51.06	51.13	51.20	51.27	51.34	51.41	51.48	51.56	51.64
67	51.72	51.79	51.86	51.93	52.00	52.07	52.14	52.21	52.29	52.36
68	52.43	52.51	52.58	52.65	52.72	52.80	52.87	52.94	53.01	53.08
69	53.15	53.22	53.30	53.37	53.45	53.52	53.59	53.66	53.73	53.80
70	53.87	53.95	54.02	54.10	54.17	54.25	54.32	54.39	54.46	54.53
71	54.60	54.67	54.75	54.82	54.90	54.97	55.05	55.12	55.19	55.26
72	55.33	55.41	55.48	55.56	55.63	55.70	55.77	55.85	55.92	55.97
73	56.05	56.13	56.21	56.28	56.35	56.42	56.50	56.57	56.65	56.73
74	56.80	56.88	56.95	57.03	57.11	57.18	57.26	57.34	57.42	57.50
75	57.58	57.67	57.75	57.83	57.92	58.00	58.09	58.17	58.26	58.35
76	58.43	58.51	58.60	58.69	58.77	58.86	58.95	59.04	59.13	59.22
77	59.31	59.40	59.49	59.57	59.05	59.74	59.82	59.91	59.99	60.08
78	60.17	60.25	60.34	60.43	60.51	60.60	60.69	60.77	60.86	60.95
79	61.04	61.13	61.21	61.30	61.39	61.47	61.55	61.64	61.73	61.82
80	61.91	61.99	62.08	62.17	62.25	62.34	62.43	62.51	62.60	62.69
81	62.78	62.87	62.96	63.05	63.14	63.23	63.32	63.41	63.49	63.57
82	63.65	63.74	63.82	63.91	64.00	64.08	64.17	64.26	64.34	64.42
83	64.50	64.58	64.67	64.75	64.84	64.92	65.01	65.10	65.19	65.28
84	65.37	65.46	65.55	65.64	65.72	65.81	65.89	65.97	66.06	66.15
85	66.23	66.31	66.40	66.49	66.58	66.67	66.76	66.84	66.93	67.02
86	67.10	67.19	67.28	67.36	67.45	67.53	67.62	67.71	67.79	67.87
87	67.96	68.04	68.13	68.21	68.30	68.38	68.46	68.55	68.63	68.72
88	68.80	68.87	68.95	69.03	69.11	69.19	69.25	69.32	69.39	69.45
89	69.50	69.55	69.60	69.65	69.70	69.74	69.78	69.82	69.85	69.89
90	69.93	69.97	70.00	70.02	70.04	70.07	70.10	70.13	70.16	70.19
91	70.21	70.23	70.26	70.29	70.31	70.33	70.35	70.37	70.39	70.41
92	70.43	70.45	70.46	70.47	70.49	70.51	70.53	70.54	70.56	70.58
93	70.60	70.61	70.63	70.65	70.66	70.67	70.68	70.70	70.71	70.73
94	70.74	70.76	70.77	70.78	70.80	70.81	70.82	70.83	70.85	70.86
95	70.87	70.89	70.91	70.92	70.93	70.95	70.96	70.97	70.98	70.99
96	71.00	71.02	71.04	71.05	71.06	71.07				

By Dulong's formula the calculated heat value for the above sample is:

$(14{,}550 \times 0.59) + 62{,}000\ (0.0563 - 0.0244) + (4050 \times .0403) = 10{,}713$ B.t.u.

As a matter of interest it should be noted that the actual ultimate analysis as determined by the United States Bureau of Mines for the above sample, as fired, was: carbon, 58.69; hydrogen, 5.71; nitrogen, 0.95; oxygen, 19.88; ash, 10.74; sulphur, 4.03 per cent. The actual heat value was 10,807 B.t.u. Here again the error in the calculated heat value is less than 9/10 of one per cent.

Costs of Conducting

DUST COLLECTOR EFFICIENCY TESTS

Now that technique for testing dust collectors has been determined by the American Society of Mechanical Engineers, the expense involved is the subject discussed in this article and indicates wide variations

By LOUIS C. WHITON
Prat-Daniel Corp.

SINCE the use of dust collectors in coal fired plants has become so general, and as a suggested code for testing efficiency has been presented by the American Society of Mechanical Engineers, it will be of interest to examine data concerning the costs of making such tests. These data have been obtained from the records of the writer's company, and also of those of two other manufacturers of dust collecting apparatus.

Testing the efficiency of dust collectors is as yet a relatively new technique, and there are not many engineers competent to run an accurate test. It is to be hoped that as time goes on, means may be found to reduce the costs recorded herewith, but it is doubtful that it will ever be possible to reduce them to any marked extent, since the technique of efficiency testing will always remain difficult and complicated.

The cost of testing may be divided into the following three parts:

1. Preliminary investigation and trial test.
2. The actual test.
3. Preparation of reports and laboratory work.

*A paper presented before the Metropolitan Section of the A.S.M.E.

Test A

This test was made in connection with a group of Thermix Multicyclones installed at the plant of the Industrial Rayon Corp., in connection with three 90,000 lb. boilers. Due to the fact that extreme accuracy of testing was desired, fourteen 7-hr. tests were run over a period of 14 days. This is, of course, more than would normally be required.

Preliminary work occupied approximately 3 weeks, with the constant service of chief engineer, assistant and one or two helpers, because the duct layout made it extremely difficult to obtain satisfactory and uniform samples. Also it was necessary to make changes in order to weigh the dust collected in the hopper. In the following costs, and in subsequent ones, an arbitrary figure of $100 per week is taken for the chief engineer or his assistant's time, since it does not seem quite fair to charge the full salary of an executive who happens to be assigned to this important work, because in the future such executives would not be required. The figures for the costs given have been simplified by omitting the amounts less than one dollar. The costs are as follows:

Travel and living expenses for engineers sent from manufacturer's plant at Port Chester, N. Y., to Painesville, Ohio	$ 860.00
Pay to outside labor help for operating test	282.00
5 weeks, chief engineer and assistant	1,000.00
5 weeks, assistant test engineer	350.00
Report preparation	200.00
Laboratory work	75.00
Total	$2,767.00

By having the tests operate one week instead of two, this amount might have been cut down three or four hundred dollars.

Test B

This test is given as a typical one in connection with a public utility. It was run to test the efficiency of Thermix Tubular Dust Collectors at the Burling Slip Station of the New York Steam Corp., connected with Consolidated Edison Co. of New York. The location was near the Prat-Daniel Corp. offices and plant, and therefore travel expenses were at a minimum. The test occupied one month, and the following were the costs of the manufacturer:

Travel and expenses to the plant	$ 135.00
Outside labor and shop labor preparing apparatus	290.00
3 weeks chief engineer and assistant, at $200.00 for both	600.00
4 weeks test engineer at $50.00	200.00
Preparation of report	150.00
Laboratory report	75.00
Total Cost to Contractor	$1,450.00

The following additional information has been given by Mr. Griswold Denison of the Consolidated Edison Co. of New York, Inc., concerning the additional costs for this test to that company.

Preliminary time	150	Man Hours
Testing time	520	" "
Time preparing report	100	" "
Total	770	" "

The cost of this item was $1,347.50, and that was charged to the Technical Service Department. The total is correct, but the sub-divisions have been estimated. The 150 man hours were

spent in getting ready and some preliminary runs.

In addition to this, approximately $50 was spent for scaffolding, and is estimated. Labor at the station for setting up this scaffolding is estimated at $100. The total cost to the station was, therefore, $1,497.50.

If this is added to contractor's cost, the total cost of the test was $2,947.50, and there is little doubt that there are various overheads and other unrecorded additional costs, especially in connection with this test, which easily brought the total amount to considerably over $3,000.

Test C

Mr. Messenger of Buell Engineering Co., Inc., has kindly submitted the following facts concerning tests which that company operated for the Virginia Electric and Power Co. in Norfolk.

The field work consisted of 4 days of the chief engineer, 10 days of the laboratory manager, and 5 days each of a junior engineer and laboratory assistant. It is interesting to note that he records that the report required 10 days of the chief engineer and 7 days of the junior engineer. This is not surprising because there is a great deal of calculation in the preparation of such reports.

The total, including traveling, living expenses and freight, was	$615.89
To this, there is an overhead, which includes laboratory expense and stenographic expense, of	393.00
This makes a total cost to the contractor of	$1,008.89

In addition to the work furnished by the contractor, it was necessary that the client assign his engineering representative to the test, and to build necessary scaffolding, supply and repair holes in the breeching for testing, and it is estimated that the cost to the client was approximately $500, making a total of $1,500.

Test D

Mr. H. O. Danz of the American Blower Corp. states that field tests require from 10 days to 3 weeks, plus laboratory work and report preparation. Since the distance between the manufacturer's plant and the installation will vary, precise figures are difficult to determine beforehand, but he estimates the following:

Cost of material for test	$50.00	$150.00
Average traveling and living expense for test engineer	200.00	350.00
Total cost to customer and manufacturer for operating test	900.00	1,500.00
Total cost of operating such test	$1,150.00	$2,000.00

To summarize the above, these records are as follows:

TEST A, large industrial plant. Actual cost	$2,767.00
TEST B, large public utility. Actual cost	$2,947.50
TEST C, Virginia Electric and Power utility. Actual cost	$1,500.00
TEST D, American Blower Corp. Lowest estimate	$1,150.00
High estimate	$2,000.00

The average of all of these figures from various sources is $2,073.00.

It is fair to assume that a test which can be easily run because of the duct layout, and where a great many points are not required over the efficiency range, will cost between $750 and $1,500.

An extensive test, with a number of points, will cost between $1,500 to $3,000, and the writer does not believe that a test of great value can be operated for less than $750, and this is assuming that the manufacturer provides without cost, the necessary sampling equipment.

It might be stated that, certainly for some time to come, appropriations should be made for testing of dust collectors, since these are a relatively new device, and it is only by the most exhaustive research of this nature, that reliable information can be obtained as to the effectiveness of one type of design or another.

Furthermore, it is recommended that in every dust collection installation, the engineers plan on designing the dust outlet from one typical dust collector in such a manner that the dust can be weighed during a test. This is most obligatory for preparing testing, since the weight of dust caught against the sample in the outlet gas is probably the most accurate means of testing. Furthermore, there are instances where it is impossible to obtain fair samples in the ductwork because of their design. In such a case an approximation of the efficiency, at any rate, can be obtained by equating the dust actually caught against the total calculated dust, which is a function of the ash in the coal, and the dust or ashes, plus their carbon content in the furnace flues and dust collector. Much of the cost of testing is consumed in modifying hopper outlets to make it possible to weigh this coal during the test, and this could be avoided to a great extent if this is planned when the installation is designed.

Since dust collection apparatus is generally sold on a guaranteed collection basis, it is reasonable, therefore, for the protection of the purchaser, and also for the protection of the various bidders offering dust collectors, to determine whether the guarantees have been met. It is urged that such tests be made wherever possible, unless the purchaser is satisfied that there is a similar installation with similar methods of coal firing which has already been tested, and which might, therefore, make it feasible to waive such an expensive operation as testing. This should certainly be the exception, however, rather than the rule.

Insulation

CHANGES MADE in the method of insulating hot-water storage tanks, open and closed heaters, have proved a decided improvement from the standpoint of continued good appearance and greatly decreased maintenance costs.

These changes consisted of replacing the canvas covers with approximately ⅛ in. (finished thickness) of a plastic-asphaltic coating troweled on over the smooth-finished cement, applied to the insulation blocks. This coating, which can be primed with aluminum paint and given a finish coat of any desired color, remains reasonably soft, ductile, and entirely free from the numerous cracks normally appearing in a smooth coat of asbestos cement.

This same type of covering is being used to some extent on air ducts, insulated externally. In this case, however, the frequent changes in temperature of the duct itself cause cracks to form at the corners. It is hoped that a scheme of using metal corner beads, something like those used in house plastering, may prove to be the solution to this difficulty.—J. A. Keith—an A.S.M.E. discussion.

RECENT DEVELOPMENTS IN WATER TREATMENT

Steady advances have been made and are being made both in the direction of producing water of finer physical and chemical quality as well as in reducing costs of treatment. Industry is requiring better control of the quality of water for processes and steam generating purposes. This article describes certain equipment used for eliminating physical impurities in water. A subsequent article will deal with chemical impurities.

BY S. B. APPLEBAUM*

PHYSICAL impurities in water that have received attention in recent years are (a). turbidity, color, algae or microscopic organisms and organic matter; (b) gases, taste and odor. The more complete removal of these impurities has been called for by paper manufacturers, textile plants, carbonated beverage firms and all users of large and especially high pressure boilers. Improvement in coagulations accomplished the successful reduction of the first group of impurities.

Mechanical Floc-formers

Until fairly recently the importance of proper floc formation in order to improve coagulation of these physical impurities had not been appreciated. The chambers for mixing the coagulant and water were usually inadequate and the settling tanks were therefore made excessively large to compensate for this. It has now been demonstrated that mechanical agitation, properly controlled, will not only accelerate the floc formation, but produce a tougher and more readily settleable floc. This permits smaller settling basins, thus saving initial investment, reduces the operating cost by saving coagulant and produces a better effluent.

Figure 1 shows the Permutit mechanical floc-former. It is a two-stage agitator. The first stage is a flash mix, usually of about 5 min. retention time to mix the chemicals and water together. The second stage is the rolling mix of about 20 to 60 min. retention time, where the precipitate is agglomerated into heavy, tough particles, easily settleable, but not easily dispersible. Both steps are operated at the same peripheral speed, but the flash mix has close spacing of rotors and stators to accomplish the desired degree of agitation. The rolling mix design consists of a series of vertical blades supported between horizontal beams. These blades are inclined to the plane of the beams supporting them. On one side of the vertical shaft they are inclined in one direction and on the other side, they are inclined in the opposite direction. As the agitator rotates, the inclination of the blades causes the water to roll laterally in eddies across the tank, eliminating dead spaces and insuring uniform velocities in all parts of the tank.

Since the agitators must be in continuous operation, in many cases 24 hr. a day, the floc-former has been designed to avoid any underwater bearings carrying heavy loads or submerged chains that may corrode and give difficulties.

Further improvement in floc formation has been accomplished by proper control of the pH value and by addition of special chemical aids to coagulation such as sodium silicate and clay. Figures 2 and 3 show the effects of mechanical agitation as well as clay.

It has also been found that recirculation of sludge also aids coagulation by providing nuclei to which the precipitate adheres.

Spaulding Precipitators

The beneficial effect of recirculating settled sludge in aiding precipitation logically led to the development of the sludge blanket type of equipment. In this design, as shown in Fig. 4, the sludge is never allowed to settle out at all. A mechanical agitator in the bottom of the tank keeps the sludge particles suspended. After thorough mixture of chemical, water and sludge, the mixture rises upward through a suspended sludge filter zone, so arranged that the upward water velocity continually decreases. The height and density of the sludge filter are controlled by regulated desludging and the upward velocity. When the water reaches a certain level, it separates from the sludge and emerges clarified.

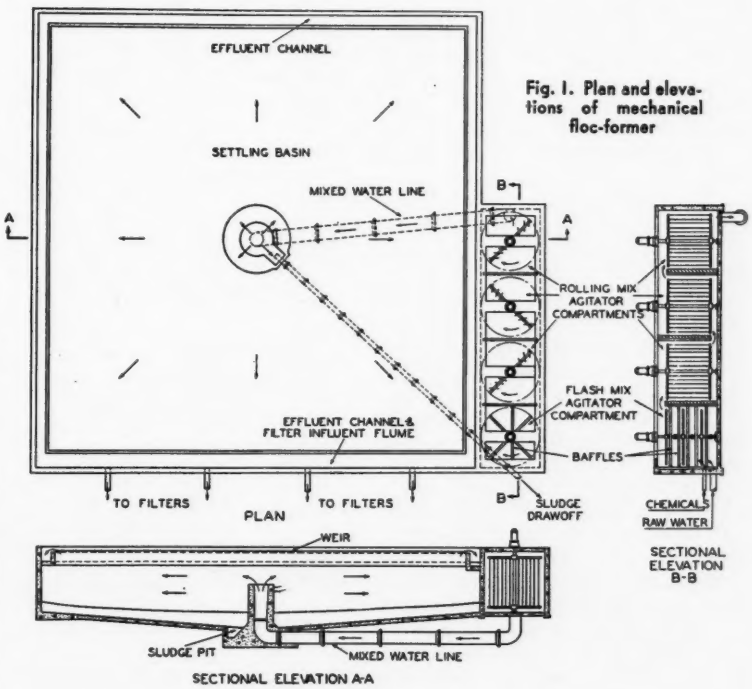


Fig. 1. Plan and elevations of mechanical floc-former

*Vice President, The Permutit Co. From a paper delivered before the Engineers Society of Western Pennsylvania.

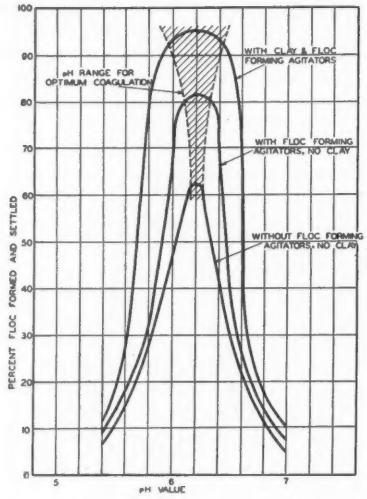

WITH CLAY & FLOC FORMING AGITATORS
pH RANGE FOR OPTIMUM COAGULATION
WITH FLOC FORMING AGITATORS, NO CLAY
WITHOUT FLOC FORMING AGITATORS, NO CLAY
PERCENT FLOC FORMED AND SETTLED
pH VALUE

Fig. 2. Variation of floc formed and settled with pH value

This design has met with such favor that, up to date, over 130 of these precipitators have been installed or are under construction. They are handling successfully, waters like the Mississippi River with turbidities at times exceeding 3000 p.p.m.

Taste and Odor Removal

Taste and odor in water, due principally to certain microscopic organisms and organic matter, have been successfully removed by improved coagulation and by the use of activated carbon. This carbon may be employed in granular form in filters and the absorptive effect of the carbon takes place as the water percolates down through the filter bed of carbon. A large number of these granular carbon filters have been installed in industry for this purpose.

For larger plants, the continuous feeding of powdered activated carbon into settling basins has been utilized for taste and odor removal. The amount of carbon fed is more or less proportional to the intensity of taste and odor in the raw water, as measured in threshold units. For waters of high taste and odor, the cost of the carbon is appreciable. It has been found by a recent, carefully conducted pilot plant test, running for several months, in a case out west, that the Spaulding precipitator when used for simultaneous lime softening and taste and odor removal by powdered activated carbon results in a saving of 25 to 50 percent of the carbon which would be required in a typical old-fashioned settling tank. This greater efficiency of the carbon is due to two factors. One factor is the suspension of the carbon in the sludge filter zone. The carbon is utilized completely and is not wasted by settling out unused. The second factor is the concentration of carbon in the sludge blanket. By accumulating a dense blanket of sludge and carbon particles, a great excess of carbon is on hand to complete the taste and odor removal.

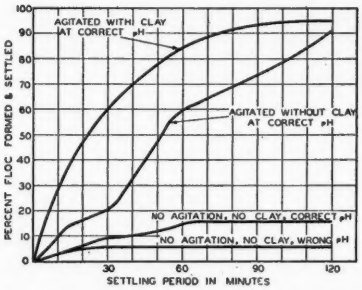

AGITATED WITH CLAY AT CORRECT pH
AGITATED WITHOUT CLAY AT CORRECT pH
NO AGITATION, NO CLAY, CORRECT pH
NO AGITATION, NO CLAY, WRONG pH
PERCENT FLOC FORMED & SETTLED
SETTLING PERIOD IN MINUTES

Fig. 3. Variation of floc formed and settled with time allowed

Degasifier for Gas Removal for Cold Water

Gases dissolved in water, such as hydrogen sulfide and carbon dioxide are objectionable to various industries. Carbon dioxide accelerates corrosion of steel piping and tanks. This not only affects the life of these metal parts, but the iron picked up by corrosion makes the water unsuitable for many industrial processes. Carbon dioxide may, of course, be neutralized by addition of alkalis such as lime or soda ash. But when the CO_2 is high, this chemical neutralization is expensive. Furthermore, the chemicals added stay in solution and thus increase the total dissolved solids of the water which is undesirable for many industrial uses. Mechanical degasification is therefore to be preferred.

Open coke or other tray aerators have been used for a long time to remove gases. But these presented the objections of subjecting the water to dust and other atmospheric contamination, as well as troubles from freezing and loss of water by winds and consequent wetting of nearby objects. Spray systems have been satisfactory but required excessive floor space. Considerable research was therefore devoted to perfecting a mechanical degasifier to avoid these difficulties. Figure 6 shows the design developed that is now in satisfactory use.

This design employs a closed, non-ferrous shell, containing a multiplicity of staggered trays and a motor-driven blower discharging air upwardly and countercurrent to the downward trickling water. The water and air are distributed uniformly to provide effective degasification with a minimum of air. It occupies little floor space and may be conveniently located either inside or on top of buildings.

This degasifier has found application as a final step after hydrogen zeolite to remove the CO_2 formed by that process. But a number of large degasifiers have also been installed to degasify cold well waters for corrosion control. The CO_2 in the effluent is reduced to below 5 p.p.m. and then a very small amount of lime or soda ash is added, so that the pH is raised sufficiently, according to the index worked out by Professor Langelier, to inhibit corrosion by the protective coatings formed by the water inside the piping, etc. The temperature of the water is unaffected, so that the cooling value of the well water is preserved. The most recent degasifier installation for this purpose is for a capacity of 36,000 g.p.m., consisting of four

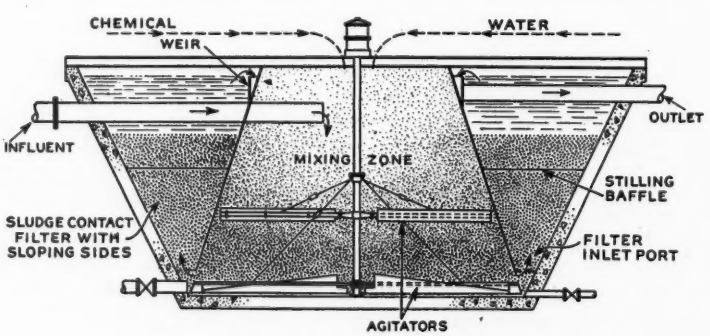


Fig. 4. Cross Section of Spaulding Precipitator

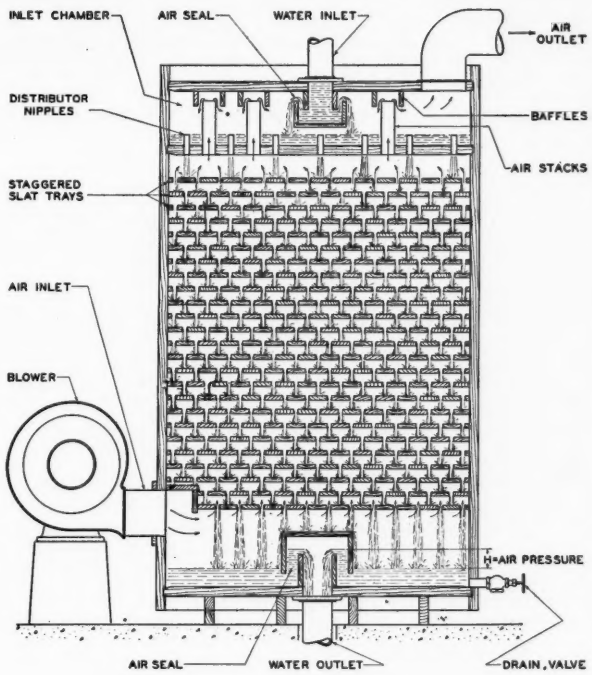


Fig. 5. (Left) Degasifier for treating cold water

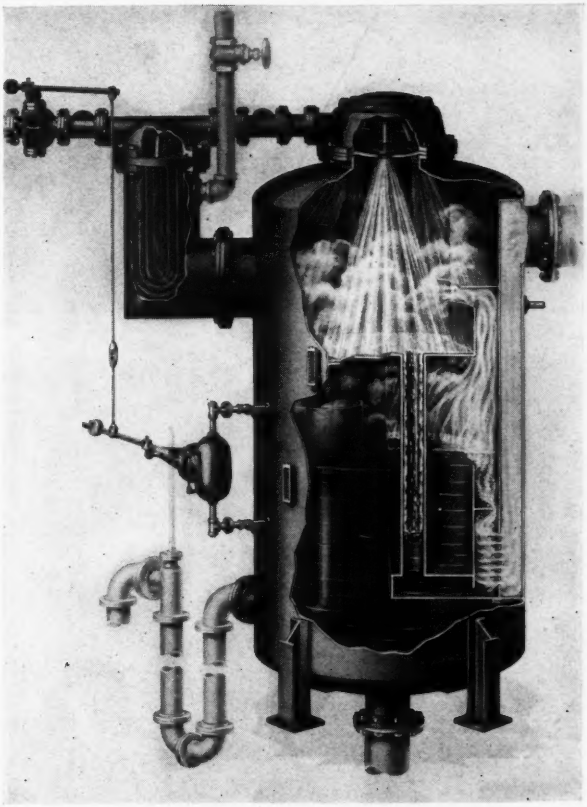


Fig. 6. (Right) Cut-away view of deaerating heater

units 24 ft. diameter by 20 ft. high.

Another application of degasifiers is to remove initial high amounts of CO_2 ahead of open feedwater heaters, so that these heaters can then finish the removal of the CO_2 and thus avoid any CO_2 entering the steam boilers. If the carbonate alkalinity of the feedwater is reduced to nearly zero and the free CO_2 is also reduced to zero, the final steam generated by the boilers is free from CO_2. When steam containing CO_2 is condensed, the condensate is corrosive to the return pipe lines. This is a serious problem to many boiler plants, especially to central steam heating plants who sell steam to industrial users. A number of degasifiers were installed in central steam heating plants for this purpose.

Deaerator for Removal of Dissolved Gases

In the boiler feedwater treatment field, a recent development of importance is a new deaerating heater. Most of the previous deaerator designs in use employed a multiplicity of trays to allow the water to trickle down through the steam. This gave difficulties due to serious corrosion of the trays, even if made of cast iron. Furthermore, complete removal of carbon dioxide gas was not obtained under certain conditions. Figure 6 shows the new design.

The deaerator has two compartments, a preheating spray chamber and a final scrubber. The steam enters the scrubber first and then enters the preheater. Thus the steam flows counter-current to the water. The preheater heats the water to within 3 or 4 deg. F. of the steam temperature and most of the dissolved gases are liberated and escape through the vent condenser. The steam passing first through the scrubber is gas-free and very little of it is condensed in the scrubber. Therefore, a tremendous excess of gas-free steam scrubs the preheated water thoroughly and eliminates all the residual gas completely.

Simplicity of construction lends itself to convenient protection of the interior of the steel preheating chamber and vent condenser with stainless steel or other non-ferrous linings. The scrubber and storage compartments are usually not so lined because the gas-free water in them is not corrosive.

Where hot lime soda water softeners are employed, the same design of deaerator is embodied within the settling tank.

The table gives the performence of one of these deaerators following a zeolite and acid feed. The capacity is 1,400,000 lb. per hr.

Performance of deaerating heater at large southern oil refinery

	Water entering deaerating heater						Water leaving deaerating heater						
			Alkalinity as $CaCO_3$						Alkalinity as $CaCO_3$				
No. of Tests	Rate of deaeration lb./hr.	Oxygen cc/l.	Bicarbonate ppm	Normal Carbonate ppm	Free CO_2 ppm	pH	Temp. °F.	Oxygen cc/l.	Bicarbonate ppm	Normal Carbonate ppm	CO_2 Free	pH	% rated Capacity
4	350,000	5.0	20	0	3	7.0	69	0.00	9	8	0	8.9	25
5	650,000	5.0	20	0	3	7.0	73	0.00	9	8	0	8.8	46
6	950,000	5.0	18	0	3	6.9	80	0.00	7	8	0	8.8	68
After feeding sulphuric acid into water inlet pipe ahead of heater													
2	650,000	5.0	10	0	8	6.5	80	0.00	4	5	0	8.5	46

The determinations reported are average readings for the number of tests reported in first column.

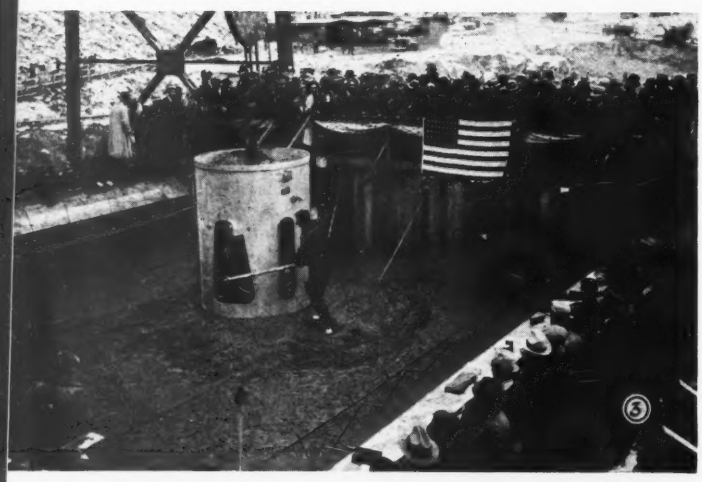
Grand Coulee

AS REPORTED on page 48 of this issue, the power plant at Grand Coulee Dam was formally placed in operation with the starting of the first 10,000 kw. generating unit on March 22. On that day the plant was cut into the Bonneville transmission line and began delivering kilowatt hours for the normal and defense needs of the Pacific Northwest.

On these 2 pages we have assembled a few photographs covering the construction of this great dam from the beginning. In less than 8 yr. this dream of a half century was brought to realization. It was an ambitious undertaking—the most ambitious ever undertaken by man in fact, but with the experience gained in the construction of Boulder Dam and two other dams which in their time were outstanding in all the world, the engineers of the Bureau of Reclamation went to work with confidence and enthusiasm.

As shown by photograph 1, in January 1934 only a fringe of tents bordered the Columbia River where it bends its ancient course northward in central Washington. These tents housed the engineers whose investigating job was almost over and who were then beginning the execution of the precise blueprints of the dam. Uncounted centuries before, a glacier had blocked the Columbia at this point causing the river to shift its course eastward. Centuries later when the sun had melted the glacier the river returned to its former and present course, leaving behind the great channel it had plowed eastward—the Grand Coulee. Now it was to be blocked again by a great dam made by man.

Photograph 2 shows preliminary excavations to smooth bedrock for the foundation of the dam. This meant digging a 35 acre hole to hardrock and the removal of 44 million tons of earth and rock.



In picture number 3, we see the first bucket of concrete being tripped by Governor Clarence Martin of Washington on December 6, 1935. After that only 2,624,999 bucketfuls remained to be poured. Each bucket load added 4 cu. yd. (8 tons) to the concrete substance of the dam.

In photo number 4 we see the work as it had progressed by the spring of 1937. A great cofferdam has been built halfway across the river and the

Goes To Work

first steel concrete distribution trestle is being built. This trestle and two others built on top was later absorbed in the concrete structure of the dam.

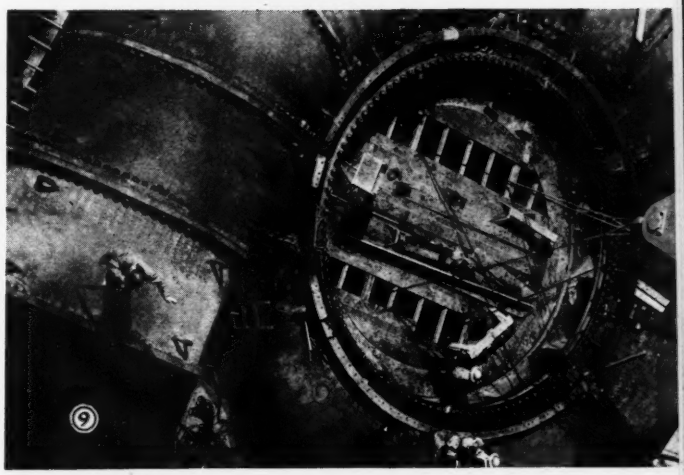
Early in 1936 a stubborn problem was encountered while excavating for the east section. A 400,000 ton mass of plastic clay began to move toward and fill a deep crevice in the bedrock. This meant serious delay and great expense for its removal. What did the engineers do? They stopped it cold, literally, for they froze it. Six mi. of pipe were driven into the clay between the walls of the crevice and brine at 0 deg. F. circulated through the pipes for 9 mo. from Aug. 1936 to April 1937. This is shown in Fig. 5.

Photograph number 6 shows the dam in March 1938. Concreting has spread across the ¾ mi. length of the dam and the river is slipping through the alternate slots in the central section for the last time. By the spring of 1939 these slots had been closed and the river was blocked. Storage began.

On October 2, 1937, President Roosevelt made his second visit to the dam. His first was in 1934. In photo number 8 he is shown taking time out for a luncheon from the contractor's mess hall. Frank A. Banks, supervising engineer for the Bureau of Reclamation at the dam, is at the President's right.

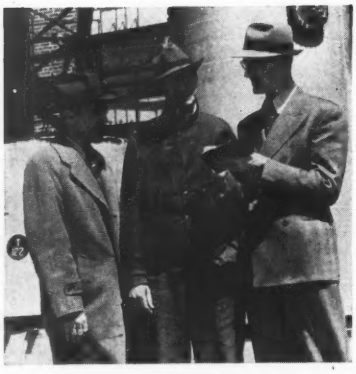
In Fig. 9 is shown a partial view of the scroll case for the first of the 150,000 hp. turbines. There will be 18 of these huge machines in the completed plant.

Photographs 7 and 10 show two views of the dam as it is today, practically complete. In Fig. 7 at the right below the dam, is the first half of the power house. In this building (hold your breath and take another look at the picture) three blocks long and 24 stories high will be housed the world's largest generators. The plant will ultimately have a capacity of 1,944,000 kw. or 2,700,000 hp. The dam forms a lake 151 mi. long. In addition to supplying electrical energy for use in the northwest, the generators will supply power to drive 12 of the world's largest pumps which will pump water from the river into the Grand Coulee—the balancing reservoir 280 ft. above the dam where water will be stored to irrigate the 1,200,000 acres which the project will serve.



'Round About

with the Engineering Editor



At the Durez Plastics and Chemicals plant, N. Tonawanda, N. Y. (see article page 93 January 1940) from left to right, Glenn M. Loomis, chief engineer and author of the article, and Robert M. Crawford, production director in complete charge of the plant, listen to Dr. Walter Prahl, co-inventor of the Raschig process for producing synthetic phenol, invent a good story under the guise of serious business.

* * *

Drafting costs . . . in one large utility engineering concern the average draftsman completes 120 sq. ft. of drawings per year at a labor cost of about $20.00 per sq. ft. . . . On one typical station alone there were 841 drawings, averaging about 15 sq. ft. each.

* * *

Without presuming on a new status as classmate of a group of distinguished engineers at Fostoria's February Infra Red Class, I can mention that the group included the following utility representatives: N. F. Vidal, Jr. and Albert D. Beck of the Pennsylvania Power Co.; Allan Smith of the Northern Elec. Co. Ltd.; J. W. McMurray of the Ohio Power Co.; and R. B. Dunnavan of the Northern States Power Co.

* * *

For smoothing out crumpled and folded blueprints, Chas. A. Hamilton of Hamilton and Weeber, Grand Rapids, recommends an electric flat iron.

* * *

The University of Illinois was the first American college to introduce machine shop courses . . . 1870 . . . A more recent note reports considerable success cleaning scaled water heaters with acid . . . a small motor driven stainless steel centrifugal mounted on skids circulates the acid . . . an oil drum cut in two holds the acid . . . Peak load on the municipal system at Brookings, S. D., is approaching 1500 kw. . . . Thomas W. Newell is superintendent.

BRILLIANTLY lighted industrial towns of Ohio and eastern Indiana are a great contrast to the rural villages of western Indiana and eastern Illinois . . . here the city fathers feel the night was made to sleep in and save the kilowatts . . . but light or dark, the towns all ooze cars like juice from a crushed grape . . . Pulling in the sidewalks at nine doesn't seem to cramp the style of the younger generation.

In California they build aeroplanes, import movie stars and design power plants in the grand manner . . . At Burbank, J. H. McCambridge is supt., Public Service Dept. . . J. B. Johnson (who was smelter chief engineer while I was in the power plant at the United Verde Copper Co.) is mechanical engineer . . . At Glendale Peter Diederich has been supt. P. S. Dept. for over 20 yr. . . . O. H. Hedrich, mechanical engineer, was loaned by the City of Pasadena to build the new plant . . . F. E. Weymouth, G. M. & C. E. Metropolitan Water Dist., Los Angeles, used to be with the Bureau of Reclamation.

V. F. Parry, Bureau of Mines, Golden, Colo., who made a trip east to catch up on coal research, will have something new on coal drying to spring soon . . . Stephen C. Casteel is chief engineer of the Davenport (Iowa) Water Company . . . he is also president of the N. A. P. E. this year . . . S. R. Ferris, C.E. of the REA Diesel plant south of Winchester, Ill., can look at his load chart and tell what his customers are doing . . . they milk, cook, wash and iron with regularity . . . Nearby at the Jacksonville, Ill., municipal Diesel plant W. B. Kesstner is chief.

John Drabelle, consulting engineer, Iowa L & P, Cedar Rapids, reports a long period of successful parallel operation with industrial plants . . . Pennick & Ford, Walter Rutz, Master Mechanic, is one of these . . . The S. S. Davis Water Power Co., Rock Island, is reconstructing its hydro station adjacent to the Moline Rock Island Power Co. steam plant in Moline . . . four 800 hp. S. Morgan Smith wheels . . . Ralph Thomas, Minneapolis, is consulting engineer . . . There are three Hobart Cos. in Troy, O., welders, metal furniture and food grinders . . . the last Hobart Mfg. Co. recently installed a new Springfield boiler, Taylor stoker, Askania control . . . high pressure, anticipating a top turbine later . . . Tom Sherman is electrical engineer, W. H. Hipshire, supt. of power, and L. D. Davis chief . . . W. I. Barrows of Dayton was consulting engineer.

Observations on theatre cooling by E. R. Ross, mechanical engineer for Bevington & Williams of Indianapolis . . . complaints are reduced by maintaining a constant 76 deg. rather than the usual 10-12 deg. differential between outside and inside . . . Patrons moving around during change of programs stir up sufficient warm air to increase the temperature from 3 to 4 deg. . . . Tom Wharf is chief engineer of the new Sunbeam Electric power plant at Evansville, Ind.

The extension to Dresser Station at Terre Haute is progressing nicely . . . drying out the first of the two 225,000 lb. per hr., 775 lb., 910 deg. F. boilers was started in February . . . R. E. Sutherland is superintendent—His brother Harry is chief engineer of the neighboring Terre Haute Paper Co. plant where J. R. Rogers is plant engineer . . . they burn 3/8 in. carbon (bugdust to you) on type E stokers.

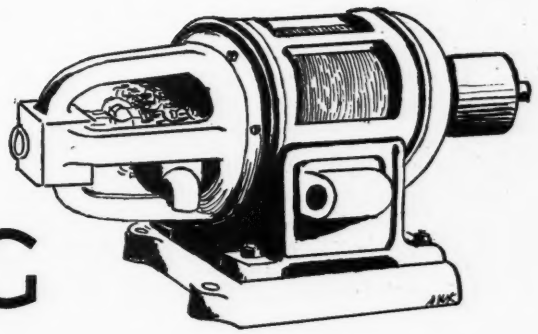
Delbert Tyron, C. E., Home Packing & Ice Co., Terre Haute, is right pleased with the arrangement worked out by Prof. Knipmeyer of Rose Poly for paralleling his two phase and three phase engine generators . . . but his real pride is the quick job he did on replacing two old boilers with a 510 hp. Bros boiler and stoker . . . steam still on the old boilers on Thanksgiving, on the new Jan. 15 . . . the change also involved a new steam header and breeching . . . "I watched three steamfitters work half an hour salvaging a fitting," he said, "and then told them to use a hammer —they had already wasted 10 times the cost of a new fitting."

M. J. Miller, recently of Goshen, Ind., Supt. of Bryan (O.) Municipal Water and Light Department since early last summer, recently added a new Nordberg . . . says the peak is now about 1500 kw.—expects it to go to 1800 by fall . . . Art Caster is chief engineer . . . In February Bryan passed from the village status and is now legally and officially a city.

Besides solving industrial lubrication problems, Frank Harvuot, S. F. Bowser & Co., Ft. Wayne, makes a hobby of old firearms . . . recently discovered a pre-Civil War Sharps in Geo. Ridgeway's collection at Wabash, Indiana . . . About 50 cal. . . . paper cartridge inserted into chamber projects about 1/16 in. Projecting end sheared off by knife edge when breech block is raised, thus exposing the powder charge to a spark from percussion cap . . . The cap fits over the nipple on the breech block and the spark travels down a drilled hole to the powder . . . Probably used by stage coach guard or pony express rider.

Richard H. Morris

MOTOR REWINDING



By C. C. HERMAN

IN MANY industrial plants operating a large number of induction motors, there will be found a considerable number of duplicate units—units of exactly the same size and speed and voltage, perhaps even the same make. This duplication is the result of standardization of electric drives, a practice which promotes interchangeability among units and avoids costly delays in production. For similar reasons, such plants may have their own rewinding departments.

In such plants there is little question as to the value of the rewinding department; it constitutes a valuable asset to the maintenance department since it eliminates delays in repairing motors, which otherwise would prove costly. If the existence of the rewinding department is predicated on the avoidance of delays in production and a reduction of capital investment through a lower inventory of standby motors, then it is of importance that such a department function with the least possible delay in rendering service.

It has been the writer's experience in supervising such a department in a manufacturing plant where over 3000 electric motors of various sizes were in use that the collection and making available of certain data connected with rewinding of motors was of prime importance. Of importance also is the necessary tools and stock of materials required for rewinding work. A rewinding department cannot be operated in a slip-shod manner. Materials of a quality equal to that used in the manufacture of motors must be used. It is poor economy to experiment with questionable materials. Motor manufacturers will gladly furnish recommendations as to quality of materials to be used in rewinding their motors, however, to the experienced motor rewinder must be left the final selection of these materials as a complete recommendation, for each make of motor is practically impossible. By making careful record of the data as each individual motor is torn down and rewound complete specifications for practically all motors will eventually be obtained.

Much can be said on this subject, however, for the present article an attempt will be made to illustrate the manner in which the motor rewind data is kept for each individual motor and the manner of collecting this data. It is to be pointed out, however, that there are several reliable sources from which the material may be obtained and since the labor of rewinding the motor is the larger part of the expense it does not pay to use second class materials. The accompanying table will illustrate the form to which the data is posted and data will be given for several standard motors.

Equipment Needed for Rewinding Dept.

Equipment necessary to set up the motor rewinding department on a minimum basis is as follows:

Coil winding machine with adjustments sufficiently flexible to produce coils for motors up to and including 15 hp. and take wire up to and including $\frac{1}{8}$ by $\frac{1}{16}$ in.

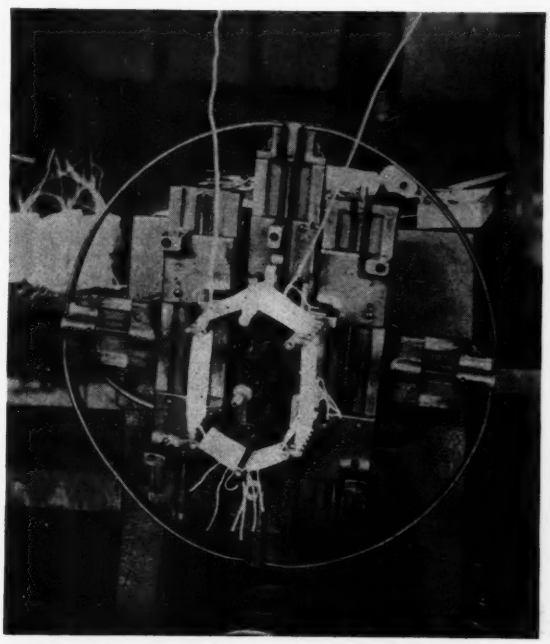


Fig. 1. Modern coil winding machine with group of coils on spindle

rectangular wire as there will be many coils for electromagnets, solenoids and other coils which can be made up on this machine and save considerable time. The coil winding machine is perhaps the most important piece of equipment in the department. It must be provided with a suitable counter and automatic cut-off which will assure that each coil of a set will have the same number of turns. It must be provided with two or more spindles so that coils of more than one strand may be wound. There should be an insulation cutter provided with the necessary adjustments to make insulation of the proper size. This cutter will also be used for cutting fish paper. Varnished cambric and fish paper is purchased in rolls, usually 36 in. wide, so that a suitable rack should be made supported above the cutting table to hold the rolls allowing the material to be pulled down across the cutting table. The cutting table should be provided with a steel edge provided with graduations in inches and $\frac{1}{16}$ in., so that the insulation can be measured and cut to size. The scale should be fastened to the table in a permanent manner on both side and front edges.

Table of Vital Motor Data

Make of motor	Allis Chalmers	Allis Chalmers
Model No.	310C-327-454-3	313C-1128-6754-32
Type	AR	AR
Frame	see above	see above
Form	see above	see above
Style	see above	see above
Phases	3	3
R.p.m.	1720	1200
Volts	440	440
Amps. F. L.	6.7	10
Horsepower	5	7½
Cycles	60	60
Materials for one motor		
Fish paper 0.010 in.	.24 yd.	.28 yd.
Var. cambric 0.010 in.	1⅛ yd.	2⅔ yd.
Var. cambric 0.025 in.	½ yd.	½ yd.
Slot sticks	14 ft. No. 19	20 ft. No. 7
Wire solder	¼ lb.	¼ lb.
Solder paste	.1 can	.1 can
Cambric tape	5 yd.	6 yd.
Friction tape	¼ lb.	½ lb.
Baking varnish	2 gal.	2 gal.
Finish varnish	½ pt.	½ pt.
SEC copper wire	20.41 lb. No. 17	20.52 lb. No. 16
RC flex. wire	5 ft. No. 12	6 ft. No. 12
Cotton sleeving	.03 lb. $\frac{3}{16}$ in.	.06 lb. $\frac{3}{16}$ in.
Vulcanized fibre		
Parawax		
Soldering lugs	3—$\frac{3}{16}$ in.	3—¼ in.
Stator winding		
Poles	4	6
Slots	48	54
Coils	48	54
Circuit	1—y	1—y
Coil pitch	1—11	1—8
Wire	No. 17—2 pr.	No. 16
Turns	No. 17—2 pr.	15—2 pr.
Wt. per coil	.43 lb.	.38 lb.
Coils per group	4	3
Unformed length of coil	10¼ in.	10 in.
Slot length		
Coil width	4¼ in.	3½ in.
Insulation size and quantity		
Sliders .010 in.	48-3½x3½ in. 48-3½x2⅞ in.	54-4x4 in. 54-4x4 in.
Coil ends .010 in.	72-5x5 in.	72-4x3 in.
Coil ends .025 in.	24-5x5 in.	36-4x3 in.
Fish paper	48-3½x2$\frac{3}{16}$ in.	54-4x2⅞ in.
Labor to rewind motor		
Clean out old winding	2 hr.	2 hr.
Cut insulation	1½ hr.	1½ hr.
Wind coils	2 hr.	3 hr.
Lay in coils	7 hr.	7 hr.
Connect, solder and tape	3½ hr.	5 hr.
Dip 3 times and place in oven	1 hr.	1 hr.
Clean and assemble	2 hr.	2 hr.
Total time for one motor	18½ hr.	23 hr.

A baking and drying oven must be included since each job must be dipped in the baking varnish and dried. The oven should be of sufficient size to accomodate the largest motor likely to be handled in the rewinding department. The oven is best heated by electricity to avoid a fire hazard of considerable proportions. It must be vented to the outside of the building since the fumes coming off the job are very dense at the start and would make the workroom atmosphere bad. There should be the usual temperature control instruments to maintain the oven at the proper temperature for baking and drying and time clock control to turn off the oven at the end of the baking period. It is not advisable to depend on the human element to take care of and control these important matters. With the time control the oven can be left on for night baking as well as Sundays and holidays without the necessity of an attendant.

Another important piece of equipment is the dip tank. Here the varnish is mixed with the volatile liquid so that due regard for the fire hazard created must obtain. The tank must be amply ventilated to the outside to carry off the fumes and provided with a tight cover to avoid an open tank in the department. The motor must be dipped into the tank and then allowed to drip a few minutes before being placed in the drying oven. For this reason a trolley track provided with an electric hoist should be provided over the dip tank and the oven. The motor is then picked up off the rewinding bench by the hoist, moved to the dip tank where it is dipped, raised out of the dip and left to drain over the dip tank the required length of time after which it is moved to the oven and lowered into same. The tank should be provided with just a small drain board so that the tank proper can be closed while the motor is draining. The motor should be allowed to drain until all dripping ceases in order to avoid producing a fire hazard in the drying oven by dripping after being placed therein.

So far the equipment mentioned is more or less standard in requirements. The winding bench, how-

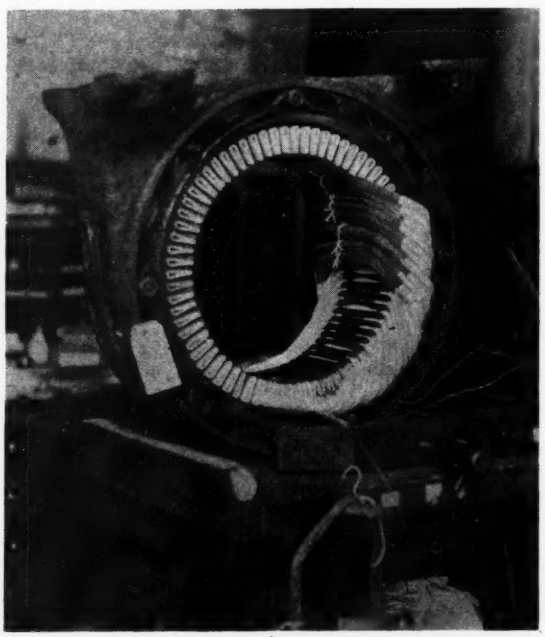


Fig. 2. Stator showing manner of insulating slots and assembling coils

ever, depends somewhat on the whim of the workman. The bench itself can be standard in dimensions, with drawers in which tools may be kept and locked. There should be a winding bracket for small motors provided with the necessary fixture for holding stators as well as rotors for rewinding. Each position should be provided with a stool as the work can best be performed sitting down.

Tools required for rewinding consist of various shapes and sizes of scrapers for cleaning the slots of all old insulating material; wire cleaners, soldering iron and gas heater or electric irons; a tank of acetylene and torch type burner for cleaning the slots and heating; a wire welding outfit for welding the coil ends together; a soldering outfit for soldering connections when welding is not specified; a pair of electrician's pliers and a pair of scissors. There are numerous other tools which may be accumulated, many of which will be found convenient, however, those mentioned above are the essential ones. The scrapers may be made of a style most convenient from old hack saw blades.

The removal of the old winding from a burnt out motor is a problem. With proper supervision and care the old winding may be burnt out by applying oil soaked waste and rags packed around the winding. I have seen motor stators completely ruined by carelessness in burning out with the use of a wood fire. If the fire is too intense the stator will be warped or the laminations will be loosened in the stator. There is also the likelihood of the slot stick holding prongs being burnt off. Any one of these things will spoil the stator. I have also seen aluminum stator frames completely melted by the burning out process, so one of the first things to do is to determine if the frame is made of aluminum or other material which will not stand high temperatures.

BITUMINOUS COAL RESEARCH

RESEARCH, following the plan adopted in a previous 3½-yr. program, and involving expenditure of $200,000 is to be inaugurated by Bituminous Coal Research, Inc., an agency of the bituminous coal industry sponsored by National Coal Assn. The object is to advance the competitive position of coal by development of better equipment for burning coal in home and industry, and arrangements have been completed by Howard N. Eavenson, president with Clyde E. Williams, director, to carry out the work at Battelle Memorial Institute, Columbus, Ohio.

Research will include studies of methods by which close control of heating and smokeless operation may be combined with the natural advantage of coal as a low-cost source of energy; the direct application of coal as a fuel for metallurgical and ceramic furnaces; methods for the complete gasification of coal for industrial and residential use; and the direct conversion to mechanical energy through the use of coal in a new type of internal-combustion engine. To get cooking and heating stoves that are smokeless and require the minimum of attention, kitchen ranges and space heaters will have a prominent place in the program, also residential stokers and coals for their use will be investigated.

Further research on materials for the dustproofing of coals, with particular attention to those porous coals, now difficult to treat economically, is expected to broaden the distribution of coal that is clean to handle.

Financed jointly by the coal producers' associations, by individual producers, and by the coal-carrying railroads, the program is set up for a minimum period of three years. While approximately 25 per cent of the country's coal tonnage is already enlisted, participation in the movement is open to all interested in the advancement of the interests of bituminous coal. E. R. Kaiser, assistant to the president, who was active in obtaining the support of the producers and the railroads, will continue his efforts to enlarge the scope of the program to a size commensurate with the importance of the industry.

With technical committee of fuel engineers representing the companies participating in the program and co-operating with the laboratory in the progress of the work, a smaller advisory group will meet with the research staff at frequent intervals to discuss the latest developments and to steer the program. At Battelle, Ralph A. Sherman, supervisor of the fuels division, will direct the work. As results are obtained, they will be quickly made available to the supporters of the program through reports and bulletins. Bituminous Coal Research, Inc., also plans to be of service to the members by consultation on specific problems, by the dissemination of information in the current literature, and by co-ordination of research on coal in all parts of the country.

C. A. Reed, engineering director, National Coal Association, is secretary of Bituminous Coal Research, Inc., with offices at 803 Southern Building, Washington, D. C., where M. L. Garvey, treasurer, and J. F. Hanley, assistant secretary-treasurer, also have their offices.

TIRES FROM PETROLEUM

CHEMIGUM is derived from petroleum by a cracking process that has been developed through extensive work and research by Goodyear Tire & Rubber Co., of Akron, Ohio. Tires of Chemical rubber have been tested over a 3-yr. period by laboratory methods and in road service, a list of 300 compounds originally investigated being reduced to 4. Results of the tests are stated to show the new Chemigum as giving performance equal to that of natural rubber, with increased tensile strength, resistance to deterioration with age, to abrasion and to effect of oils. It has possibilities for blending with natural rubber to extend the use of crude rubbers and may be processed by the same production methods and equipment as natural rubber.

Besides tires, it is being used in manufacture of gasoline hose, airplane brakes, gaskets, sealing rings and other products by the Goodyear Co.

For its production, a new plant will be located in Akron, employing 75 men, production in anticipation of defense needs to begin as soon as equipment can be installed, probably within 6 mo.

Part III—Opportunity knocks. You get a job as a refrigerating engineer but strangely enough you discover this consists of pumping heat. You don't have time to try it out, however; something else happens. You learn that ice is not made of rubber.

REFRIGERATING ENGINEER

By GEORGE HOLMAN

ON THE evening of June 30 you get a telephone call from Frosty Coldfax. "Hot evening," Frosty greets you, and you agree.

"Do you still want a job?" asks Frosty after a few remarks about the weather. "You bet," you tell him.

"Well," explains Frosty, "I'm taking over the Wholesome Ice Plant and Food Market tomorrow. You go to work in the morning as engineer and maintenance man. After things are straightened out I think you can handle both positions. Terry Letterbee did. The plant is too small for a man on both jobs."

You think of Terry's fifty a week. You also think of Terry being rolled onto a stretcher and loaded into an ambulance. "I'm not exactly a qualified engineer, Frosty," you say hesitantly. "I'll need some experience."

"Don't worry about experience," Frosty says dryly and pseudo-soothingly. "You'll get more experience than you want before the summer is over." You hear someone giggling at Frosty's end of the line. "And besides," Frosty adds, "a qualified engineer blew the place up a few days ago, and killed himself in the bargain. You can't do any worse than he did, at least, to yourself."

"I'll try to do better," you assure Frosty. "What'll I have, the graveyard shift from 11 at night until 7 in the morning?"

"No. At present Andy Piper has that shift. Before the explosion there he was ice dispenser. He took Rusty Cameron's shift when Rusty moved up to managing engineer. Andy doesn't know any more about the mechanical end of the plant than you do. I figure on moving him back to his old job. And Rusty, too. I want you to take over and manage the plant as soon as you feel you're able to."

"Thanks for the compliment," you say, this time sincerely.

"No compliment intended!" Frosty retorts, and again you think you hear that exasperating giggle at the other end of the wire. "Whenever I get ready to compliment a man I reach for my pocketbook. And besides, you'll think that this job is anything but a compliment before a week has gone by. Since the explosion at the Wholesome I have been filling their ice orders from the Aurora. We only had a thousand tons storage. And in this early summer it is doing the fadeaway. We're putting out our capacity at the Aurora, too. The Wholesome has got to produce. I know that it is only a 30 ton plant. But that much is that much. So be on the job at 7 in the morning. And bring along your pipe tools. The plant is semi-automatic. And I'll find time to break you in during the first couple of days."

In spite of Frosty's plain indication that it will be otherwise, you go to bed and have pleasant lie-awake dreams of a soft job as the future operating engineer at the Wholesome Ice Plant and Food Market. Those are the last pleasant pipe dreams you have for awhile, other than the rather natural ones you have of June Frost.

You Start on the Job

At 6:15 next morning you meet Frosty on the walk under the ice tongs. "I came over a little early," you explain your presence. "I want you to give me an outline of what I am supposed to do."

But Frosty catches you looking past him to a window of the house. When he grins, you suspect that he has seen through your alibi about why you came by his house instead of heading straight to the Wholesome. You do not see June Frost, however, and regretfully turn about and walk down the street with Frosty.

Frosty says earnestly, "Briefly, the operating engineer of a refrigerating plant must pump heat out of water in making ice, and out of enclosed spaces and the meats, fruits and vegetables, as well as other products stored in such enclosed spaces. He must do this as efficiently as possible, with due regard to the costs, the quality of the product, the proper operation of his machines, his own safety and the safety of others."

"To the engineer, the heat he handles has no substance. He can determine its presence noticeably by the use of thermometers. He will find this noticeable heat in warm water for ice making, in fresh milk, in freshly killed carcasses of animals, in loads of fruits and vegetables from orchards and farms and in air warmed by sunlight or from some artificial source. There is an unnoticeable or latent form of heat which the engineer must also take cognizance of. Such heat is found either as an essential part of a liquid, such as water, or as an essential component of a gas, such as ammonia gas. The engineer must pump out

this heat with whatever equipment he has available to do the job with."

You say, also earnestly, "My job, then, is to pump enough heat out of 30 tons of water to make it into ice. Besides, I must pump enough heat out of the rooms and coolers of the Food Market to maintain them at certain temperatures. Where does all this heat come from?"

Pumping Heat

"You already know that heat forms an essential component of the liquid called water—or of any other liquid, for that matter. Without a definite amount of heat, 144 units per lb. of substance, water at 32 deg. would be solid ice at 32 deg. In making 30 tons of ice at the Wholesome, you must pump 30 tons times 2000 lb. per ton times 144, or 8,640,000 heat units out of it. You must pump that much heat out to make a solid at 32 deg. out of a liquid at 32 deg. If the water you must make ice out of is at a higher temperature, say of 62 deg., then before you can freeze it you must pump enough heat out of it to reduce the temperature to the freezing point. Since water contains one heat unit, also called a British thermal unit, or a B.t.u., per pound per degree of temperature, you must pump out 62 minus 32, or 30 heat units to reduce the temperature of one pound of it from 62 to 32 deg. To cool the water for 30 tons of ice you must pump out an added 30 times 2000 times 30 heat units, or 1,800,000 heat units. And further, if you harvest the ice at 12 deg. above zero, you'll have still more heat to pump out of it. But ice don't run a heat unit to the pound-degree like water does. Only about half a unit. In this case, you multiply the 20 deg. drop between 32 and 12 times ½. That gives you 10 units necessary to reduce one pound of ice to 12 deg. Multiplying your 60,000 lb. of ice times this 10 units gives you an extra 600,000 heat units you must handle. Adding the latent heat of the water to the heat which must be removed to cool the water and that necessary to lower the temperature of the ice, you get a total of 11,040,000 heat units to be pumped in one day of 24 hr. That still doesn't take into account the heat seeping into the tank through the walls, bottom and top, the heat carried into the brine by the warm metal of the cans, the heat of the agitators used to circulate the brine, and other small ways that the brine picks up heat. That's why you've got to have a 40 or 50 ton compressor to make 30 tons of ice."

"What do you mean by a 40 or 50 ton machine?" you ask Frosty.

"A machine that can produce 40 or 50 tons of refrigeration, a ton of refrigeration being the same amount of cooling effect produced by a ton of ice on melting. To freeze a pound of water, you've got to take 144 heat units out of it, and for that same pound of ice so formed to return to the liquid state, it must take up 144 heat units. If it can't get the heat, it can't melt. Multiplying that 144 heat units times the 2000 lb. in a ton gives you a ton of refrigeration. Dividing our 11,000,000 heat units we figured out awhile ago by the 288,000 heat units per ton gives us 38 tons. A 40 ton compressor might take care of this load. But with high discharge temperatures and pressures, and with water at 80 deg. or so, the chances are it wouldn't."

You have a fairly clear idea as to what Frosty means by heat units and tons of refrigeration. "What am I to do with the 11,000,000 or better heat units I pump out of the water in making our 30 tons of ice?" you ask.

You are now within sight of the Wholesome Plant. "There are two common ways to get shed of the heat," Frosty says. "Soak it up in water and let it spill to the sewer. Or, you can transfer it to the wind and let the wind carry it away."

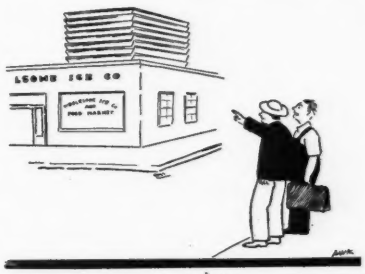
"Let the wind carry it away?" you have Frosty wound up again and keep him going by asking.

The increased tension you have put on Frosty's spring shows results. He points to the roof of the plant. "See that there Jacob's ladder up there?" he asks. "Well, that is a water cooling tower. See how those one-by-scantlings are set to dip inward? They are set that way to keep the wind from blowing the water away, while still allowing the wind to circulate between them. Some of the water blows against the boards, but it runs back into the tower and isn't wasted. The water is cooled by pumping it to the top of the tower and letting it fall down through a set of screens that you can't see from here."

You look up at the structure Frosty indicates. You have wondered what it was for. A dozen or more pigeons flutter about on top of it.

Cooling Towers

"Now, a cooling tower or spray pond is to a refrigerating plant just what your skin and your lungs are to you, or the gills are to a fish. If you use your imagination a little bit, you can see the resemblance between that tower up there and fish gills. Where you get shed of the heat generated in your body through contact with cooler air on your skin and in your lungs, and by evaporation of the sweat on your skin and the film of water on the walls of the tiny lung sacs, that tower gets shed of the heat from the plant through contact with



"See that Jacob's ladder up there?"

the air and also by evaporation of a part of the water. Of course, in an ice plant you have another way to get shed of the heat. You can just soak it up in water and let the water run to the sewer. It costs money to buy and run a recirculating pump to keep pumping the water up to the top of the tower as fast as it falls down through the screens. But it is cheaper to do that than to run it off to the sewer and buy more from the city water supply. Sometimes on still, hot days when the second atmosphere of steam has a high density—when the heat present is almost saturated with molecules of steam—cooling towers with natural circulation of air are not able to get shed of the heat being pumped out of the plant. That's why we see a lot of them with forced circulation of air. Besides buying and running a pump, you can buy and run a fan, too, and still save money over buying city water to

spill your heat to the sewer. The fan cools the water just like it cools you. It hurries up evaporation."

So far, what Frosty tells you is your job sounds easy to do. But that is the only easy part about it. As you enter the door of the plant, a robust man of about 40 meets you. "This is Andy Piper," Frosty says to you.

Andy says, "Good morning," to you. To Frosty he says, "Mr. Cross told me that you would be here this morning, and to be ready for you. Rusty and Allen know about the change, too. All of us want to hold on if we can."

Frosty says, "That'll depend. I'm going to be pretty busy at my own plant this summer. I'll have to have dependable men here, whoever they are. You can go back to taking care of dispensing and sales. Rusty and Allen will each back up a shift. Abel, here, will take over Terry Letterbee's old job."

"That's okay by me," Andy says. "I don't know much about this end of the business, anyhow. Now when Allen left the 8 by 8 going last night, and she frosted up on me, I didn't know what to do about it. At first, I thought the frost would go away. But it didn't. It got so the frost went clear around the cylinders, and the heads cooled off. I got some hot water and poured on the cylinders; but it didn't do no good either. It melted the frost, all right. But it froze right up again into clear ice. Allen told me what to do when the machine frosted up that way. But I forgot just what. Something about cutting the liquid at the by-pass expansion valve. I didn't know which valve was which; so I didn't touch any. Pretty soon something in the machine started going clickety-click. As long as that was all it done I let it go. But pretty soon it started slamming h - - l out of things inside, so I shut her off. As soon as she stopped rolling I closed every valve on the machine and the corked line from it that I could find."

Frosty looks appraisingly at Andy. "You might make a good operator in time," he says to Andy. "Do you know that with your knowledge of refrigeration, shutting the compressor off and closing those valves was the most sensible thing you could have done. That was the right thing to do. But ordinarily, when you are not sure of the right thing to do, it is best to do nothing."

But Andy is conscientious. "Allen said that the compressor would shut off automatically when the temperature got down to ten above," he goes on with his verbal report. "It was only twelve when I shut it down. That was at three o'clock. The packing leaked around the crankshaft. I took it up some; but it still leaks."

Andy doesn't need to tell you that something is leaking ammonia. Your nose has already done that. You look at the vertical twin-cylinder compressor Andy is talking about. It is the same one that blew a head ten days ago. A new head is already in place, and is readily noticeable. It is battleship gray, while the other head, as well as all other parts of the machine, is green.

The Cans Were Not All Full of Water

Andy is still worried about the brine temperature. "I'm sorry about having to shut down," he says. "The brine temperature is back up to 22."

"With the field full of water, the temperature is bound to climb pretty fast," Frosty says good-humoredly.

"But all the cans are not full of water," Andy wants to be exact. "After the explosion Rusty had only half of the field harvested. The other half had hollow cores, so he left them until he could start the compressor again. And do you know, in the whole 10 days we were down, the field temperature never rose above 33. The ice in the cans melted only ½ in. or so around the walls of the cans. And that is already frozen back up. Some of the cans . . . "

Frosty has left you and Andy and is racing up the four steps and into the tank room. You dart to the doorway in time to see Frosty jerk a hook from a nail in the wall and lift a lid of the brine tank. You follow him up onto the tank and look down at one of the two cans he has uncovered. "Of all the dumb tricks," he mutters. "Of all the dumb tricks. It's tricks like this by operators that has made me gray before my time."

Frosty looks up. "Get busy, Abel," he orders calmly. "Maybe we can save some of them yet. Take the lids off this first row of cans and throw them over there by the dump."

Wondering why the rush, you obey. By the time you get the first row of lids off Frosty has brought up a hand hoist that runs on an overhead track. He hoists a can. And while you don't know yet what caused it, you see the evidence of what Frosty called a dumb trick. The can he has hoisted has burst open vertically along a seam, the jagged slit running from within 2 in. of the bottom to within 6 in. of the top.

For the next 8 hours you are too busy to think, much less to ask questions. You pull ice. Or rather, you pull ice cans, an even 300 of them. You pull them and set them all over the place, while Frosty first goes along uncoupling small hoses from even smaller tubes over each can. Half of the cans are split vertically. Of the other half, a few of them are swollen, but most of them are good.

As soon as all the cans are out of the brine tank, Frosty starts you to dumping them. Part of his time he spends with you, the other part down in the machine room with the compressors. You notice that he has shut down the ice making compressors, and wonder why.

At two o'clock the cans have all been dumped. Frosty comes back up on the field. "It's time to quit, Abel," he says. "You have had a hard day."

"What made the cans swell up and burst that way?" you innocently ask.

"Expansion," Frosty replies briefly. "Freezing water expands more than 8 percent of its original volume in making the change into ice. Rusty should have pulled all the ice, whether it was frozen or not, and started over with the cans filled completely with water. The day after the explosion he pulled all the cakes which were completely frozen, and filled the cans with water. If he hadn't done that the brine temperature might have held these 10 days. But putting that water into it caused the temperature to rise to 32 deg. in short order. An inch or so of ice formed in the freshly filled cans, and there freezing stopped. And enough heat seeped into the tank to start the ice to melting. Meltage took place all around the insides of the cans. That didn't hurt the cans with the thin shell of ice in them. But when the meltage refroze between 4 in. of ice and the walls of the cans—As you see, the walls were

weaker than the 4 in. of ice, and something had to give."

"I've fired Rusty," Frosty tells you on the way home. "And here's some advice for you: In case you suspect that you have meltage in ice cans, say when you have had a prolonged shut-down, take a thin piece of sheet metal and see if you can get it between the ice cake and the walls of the can. If it goes even a few inches below the top of the cake, it is better to pull the whole field of cans rather than take a chance on the refreezing of the meltage bursting them. At around 5 dollars apiece, those cans run into money. Rusty's mistake will cost me an even $750."

You go home and to bed early. Stiff and sore and blistered from your unaccustomed exertion at the can hoist, you are hardly able to get into your pajamas. Your head aches, and you wish that June Frost were present to hold it. Still, you have one glorious thought in all your pains. You are now a refrigerating engineer. You have learned an important lesson from experience. That is not to try to refreeze meltage in ice cans, for ice cans are not made of rubber.

(To be continued)

THE OTHER FELLOW'S COMBUSTION EQUIPMENT

In order to draw general conclusions regarding the operation of combustion equipment in power plants, the author visited 138 plants and in this article calls attention to many points that are too frequently overlooked.

By J. C. DE FOE

PROBABLY every man sometime in his life has wondered "If the grass across the fence is actually greener than that in his own pasture." It was with this type of curiosity that this survey had its humble beginning. Slightly over 3 yr. ago a practice was started of examining personally every type of fuel burning equipment when opportunity presented itself. The information collected in those dirty piles of notes is worth 4 yr. in any man's college. To give variety to the survey, the notes flash from ridiculous and humorous theories to a profound and beneficial study of fuel conservation, without the use of a single combustion testing instrument.

One hundred and thirty-eight fuel burning installations have been observed. The types of fuels they were digesting for their heat energies were: natural gas, waste gas, prepared gas, blended fuel oils, off specification asphalts, powdered, graded and lump coal and coke. They were receiving their heat nourishment from all types of fuel servers, ranging from a worn-out scoop to combustion equipment costing its weight in gold. To speak of these fire-eaters without mentioning the personnel controlling the B.t.u.'s going to their always hungry stomachs is like trying to tell time by a clock without hands. It can't be done. Some of the firemen are just as mechanical as the fuel valves they adjust while other firemen can actually see the elusive little B.t.u.'s wiggling around in a pound of fuel or steam, begging to be unleashed efficiently so they can expend their heat wrath in useful work.

To make the magnitude of this survey understandable to the engineers and directors of fuel burning equipment, it should be stated that the capacity range of plants visited varied from 50,000 B.t.u. per hr. furnaces to a plant generating 240,000 lb. of steam per hr. at 750 lb. per sq. in. pressure, or in the director's "Measuring Stick" the fuel costs run from $48.00 to $500,000 annually.

Careful study of the notes of this survey prove that an efficient plant is the direct result of careful supervision, proper combustion and control equipment, and continuous, intelligent testing, while a wasteful plant is the result of laxity.

Fuel Must Match Equipment

Many times the power plant operators (directors) who buy fuels, specify combustion equipment to be installed, buy materials and direct maintenance are not an integral unit of power plant operation. As a result they expect the operating personnel to perform miracles any time "so-called modernization equipment" is installed. It is hoped by compiling the causes of fuel losses in 138 plants, that it will draw more attention, by those in charge, to the points now so frequently overlooked, thus aiding in the reduction of avoidable losses, which in turn guarantees higher thermal efficiency and lower fuel bills.

The staggering result of this entire survey was the general lack of knowledge on the part of power plant supervisors about the fuels they were utilizing. In several plants elaborate combustion control systems had been installed and a "straight line operation" was being maintained regardless of any variation in fuels. The extreme example of this was where a purchasing agent was buying coal on the open market and the operating force was trying to maintain the same firing conditions that were set 2 yr. before when the control equipment had been installed, the economy of this type of operation is questionable. The point of the fuel discussion is that most furnace installations are designed for one specific fuel, and their economical operation is certainly not as flexible as many operators attempt to make them. The extreme case is changing from one type of fuel to another without any alterations in furnace or operation to conform with the new fuel, yet several installations were noted where this very practice existed. Any time a change in type of fuel is contemplated a study should be made

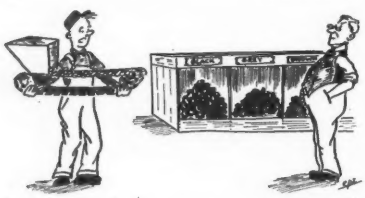
"Information collected in those dirty piles of notes is worth 4 yr. in any man's college."

of the fuel characteristics along with necessary furnace changes based on modern furnace design practices. Most large fuel producing companies have exact specifications of their products and it is possible to obtain these as well as combustion characteristics of the fuels purchased. This is especially advantageous to small and medium size plants which cannot economically maintain fuel testing equipment and personnel.

Intelligent application of fuel knowledge is only the first essential step toward fuel conservation. The second step, which stands almost in the same plane with fuels, is proper fuel burning equipment, especially burners, and grates. Many purchasers of burners have been misled by salesmen's statements that a burner designed for one type of fuel can be easily converted to handle a different type of fuel efficiently. A properly designed burner is suited, within limits, only to the fuel it was designed for, to transform it to handle any other fuel requires the same exact design knowledge that was employed in the original design.

Dirt and Wear

Three factors tending to reduce combustion equipment efficiency, most frequently noted were: dirty and worn equipment, wrong application and defective refractory.



Don't you have some coal that will match this stoker?

Dirty and worn burners—this does not mean the parts outside the furnace, for in the cleanest plant that was visited furnace inspection showed one of the four burners was completely inoperative and another one partly plugged. In many cases observed, special attention and cleaning had been given to the wrong end of the burner. This statement cannot be passed over lightly for it was true in varying degrees at every plant visited.

The fellow burning natural gas seems to feel most confident "It Can't Happen Here." He is prone to forget pipe scale and sand may eventually build up in the burners, while a slight burning is always taking place and this tends to distort gas passage leading to final stoppage. There's not a power plant operator in the country that would permit a battering ram to set banging against the tube headers and setting of his boiler, yet without a protest he sits idly by and permits dirty and worn burners to hammer all sections of the equipment with uneven firing, which sets up more devastating stresses and strains than any battering ram could hope to do. This condition was found to be so common, along with the human element aggravating it, that the operator should learn how to prove its existance by closely checking the flame fronts and brickwork color in the combustion chamber. Fortunately this condition can be corrected almost as easily as it can be permitted to exist. Put the equipment in ship-shape condition and then impress on the firemen the importance of maintaining even flame fronts by instructing them how to judge and regulate for it.

Misfits

Another factor tending to reduce combustion equipment efficiency is misfit burners or traveling grates. After some of the observations of burner and traveling grate installations one can draw only one conclusion—it is cheaper both in installation and operation to deal entirely with reliable and established burner manufacturers. Reliable burner distributors do not make absurd claims for their products. Some of the extreme misfit burners or traveling grates noted were: a set of burners capable of liberating three times the required heat input to compensate for gapping air leaks in the furnace setting; gas burners so poorly designed they were provided with ¼ in. steam atomizing nozzles to shorten the flames; a set of mechanical oil burners that rivaled hydraulic mining in drilling through the brick work at the rear of the furnace; a furnace converted from coal to combination oil and gas that smoked continuously because the doors had been drilled for the burners and the air ducts had been bricked-up, and an installation where the burners were pointed at the floor to keep the flames from going out the top of the stack.

All misfit burners cannot be recognized as easily as the few cases above, for unless a burner is properly located and designed with respect to heating surfaces, bridge wall, walls, heat distribution, heat liberation and drafts it is certainly a misfit. In other words, each burner or stoker installation is an individual problem and must be handled as such.

Defective Refractory

The third factor which upsets expected performance of any burner or traveling grate, new or old, is attempting to operate them in furnaces which, if a little cooler, would make excellent pigeon-roosts. Expansion joints in furnace walls are essential to keep the brickwork from walking out of the plant, but it is poor maintenance to consider every crack that opens to be a necessary expansion joint. Dark areas following a crack or expansion joint indicate air infiltration, consequently result in avoidable fuel losses and erratic draft conditions.

All designed joints whether between brickwork or brickwork and metal should be kept packed with a compressible high temperature insulation. Loose clean-out and peep-doors are very expensive in fuel dollars and it's absurd to let them exist.

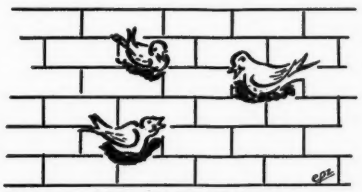
It can easily be concluded that the engineers in many of the 138 plants, which are suffering from excessively high fuel bills, should quit worrying about new burners or additional generating equipment until they have given their present equipment an even break by permitting it to operate in a tight furnace setting.

The example that best illustrates the third factor has to do with a medium size plant having four boilers, with the approximate rating of 3000 boiler hp., expansion had driven the steam output to what was considered the peak operating output. Since it was almost impossible to make even short runs without extensive brickwork repairs, the operators concluded an additional boiler would have to be added.

Faced with the expenditure of thousands of dollars the operators turned to the suggestions of the men firing the equipment. The base of every suggestion strongly pointed to poor furnace settings and baffles as being the cause of the inability of the boilers to meet the steam demand. This theme was so pronounced the operators decided to overhaul the setting and baffles of one boiler, before continuing in their negotiations for a new boiler.

This entire furnace setting including baffles was overhauled under the supervision of an expert. Without a change in another condition, the boiler gave such im-

proved performance after the revamping, that the operators issued orders for overhauling the other



"This would be okie dokie if my eggs didn't roast."

three boiler settings immediately. With other minor changes, the four original boilers are meeting steam demands with plenty of reserve capacity.

The above transformation was so pronounced because it had dual effects. One was that it proved the original steam generators had sufficient capacity to meet the requirements of plant expansion, and the other that the fuel bill per thousand pounds of steam had taken a sudden favorable dive.

Instruments Helpful

Experience in trying to sell the idea to firemen of firing with instruments caused a special interest to be taken in the combustion instruments installed in the 138 plants visited. A striking contrast was made where it was possible to have the privilege of meeting both the power plant operators and the men firing the furnaces. In three cases the operators expounded on how modern their plants were due to complete instrument control. In one case upon investigation it was found one CO_2 recorder comprised the entire instrument layout, upon inquiry among firemen it was learned the instrument had not been checked in 8 mo., yes, it had been zeroed a few times. Inasmuch as this CO_2 recorder was one of the best on the market it was "bearing false witness" on fuel conservation, because it was not given a chance to prove its worth. To get accurate results from any CO_2 recorder requires exact knowledge of fuel characteristics and periodic checking with an Orsat analyzer.

The second interesting study concerning combustion instruments had to do with a plant on which no expense has been spared to obtain the best and latest equipment, furthermore it is supervised by an intelligent foreman, yet his hair is turning white because he is unable to produce the results expected of him. Casual conversation with the firemen immediately disclosed the root of his grief, his first error was he had not tried to show the firemen the advantages of instrument firing over "eye firing," secondly he expected the firemen to fire by a string of numbers, without giving any rhyme or reason. Some of the younger men resented this "blind firing," and as a result they were constantly using the slightest excuse to turn off or disregard the instruments. Summarily he had defeated a large percentage of the advantages given by the instruments by assuming the firemen were just as mechanical as the controls they operated. It is certainly not enough just to install instruments to conserve fuels. Each fireman should be personally presented with a written set of instructions and then given an actual demonstration of how to read, interpret the readings, and operate the instrument for best efficiencies.

Suggestions

Facts gathered during the survey are summarized as follows:

1. Obtain complete information on the fuel being utilized and apply it in the fuel conservation program.

2. Educate the firemen in all phases of efficient operation and keep them informed about their progress and developments.

3. Obtain sufficient combustion and control instruments to assure efficient operation. In some plants this may mean an Orsat analyzer and thermometer while in others it might mean the installation of all types of combustion instruments with their complex controls. The number of instruments required depends directly on the degree of efficiency desired.

4. The maximum value of the first three items can only be realized when the furnace setting, baffles, combustion equipment, dampers and heating surfaces are constantly maintained in first class shape.

5. Among many small items that cost more than one thinks or wants to believe are: too much boiler output required for fuel atomization; too much draft control with burner dampers; leaky or over use of blowoff valves; improper location of soot blower elements; leaky steam connections or valves; high moisture content of fuels. A detailed investigation of each individual plant is the only way a true fuel conservation program can be successfully carried out.

Visits to 138 installations of fuel burning equipment—how interesting they all were, educational in their entirety, pleasant in their contacts, startling in their revelations! Yet, with all observations recorded in a large pile of dirty notes, not one ray of light has been thrown on the color of the grass across the fence.

National Roster of Scientific and Specialized Personnel

ONE OF THE most important phases of the preparedness program now being conducted by the United States Government is that in charge of the National Roster of Scientific and Specialized Personnel, a joint project of the National Resources Planning Board and the United States Civil Service Commission. The object of this roster is to make available in one central office an index of all American citizens who have special scientific or professional skills which may be of importance to the nation in periods of emergency and in normal times.

The National Roster of Scientific and Specialized Personnel is being developed as a means of recording in an accurate way one of the important areas of the human resources of the nation. While many specialists will be needed by the Government in a program of national defense, it is also recognized that the conservation of specialized work now being performed in private industry is of equal importance to the nation. It is most desirable not to disturb an important co-operating group of scientists in a certain laboratory if similarly trained experts not so engaged can be found elsewhere.

Persons charged with the administration of the Roster are Dr. Leonard Carmichael, President of Tufts College, who has been designated Director and James C. O'Brien, an executive of the Civil Service Commission who is the Executive Officer. Cooperating with the Roster and the joint administrative agencies are the National Research Council, the Social Science Research Council, the American Council on Education and the American Council of Learned Societies. These groups and their component societies serve the Roster in a scientific and technical consultative capacity. They have rendered much assistance in connection with the preparation of the technical check lists for the various fields of scientific specialization for each profession.

Information for the Roster is compiled through the circularization of each scientific and professional field by means of a general

questionnaire and technical check list pertaining to the particular field being surveyed. On the general questionnaire is gathered such personal and basic information as age, marital status, education, the three most significant full-time positions held, any research or special work the individual is now engaged in, any professional or semiprofessional skills acquired through hobbies and similar data.

A separate technical check list is designed for each scientific and professional field. To date check lists have been prepared for 31 different fields with 15 more in various stages of completion. The technical check list is designed to enable the individual to check the branches of the field in which he has specialized. For this reason the list is broken down into specialties as far as it is possible to do so.

It is recognized that selection of individuals for important government posts and for less important specialized activities cannot be reduced to a mechanical card-sorting procedure in that it does not accomplish a qualitative appraisal. It is anticipated that this phase of the selection process can be handled by an evaluating committee composed of individuals familiar with each specialized field.

The aim of the National Roster is the development of a means not only for the efficient and rapid, but the appropriate use of the specialized brains of America in the service of the nation. It is anticipated that as a whole those persons who are asked to lend their talents to the defense program will immediately accept. Through the use of the National Roster, it will be possible to determine the field and importance of the work being performed by the individual, thus eliminating the risk of contacting persons engaged in important private research which when completed will also add something of value to the defense program.

It might be pointed out at this point that individuals contacted through the National Roster are not drafted but are asked to lend their services to the defense program. At the same time, inclusion in the National Roster does not exempt any persons called for selective service.

ACCUMULATOR HELPS ENGINE CYCLE

BECAUSE of the thermal flywheel effect which tends to smooth out uneven steam load demands, steam accumulators have many applications. One of the most interesting installations, as well as one of the smallest yet made, is in a Pennsylvania coal mine in connection with two hoist engines hauling loaded mine cars to the surface.

In this plant, steam is supplied by four boilers at 575 lb. pressure to a 7500 kw. condensing extraction turbine. Steam extracted at 130 lb. is used for colliery demands including heating, slope hoisting engines, and for the two shaft hoisting engines mentioned above.

Capacity 440 Lb.

The accumulator, used only with the latter, is a steel vessel 10 ft. in diam. and 30 ft. long as shown by the photograph. The volume is 2125 cu. ft. and the steam capacity 440 lb. Steam is stored at up to 128 lb. pressure at periods when the engines are not using it, and discharged, down to a minimum of 100 lb. pressure, when the engines are pulling.

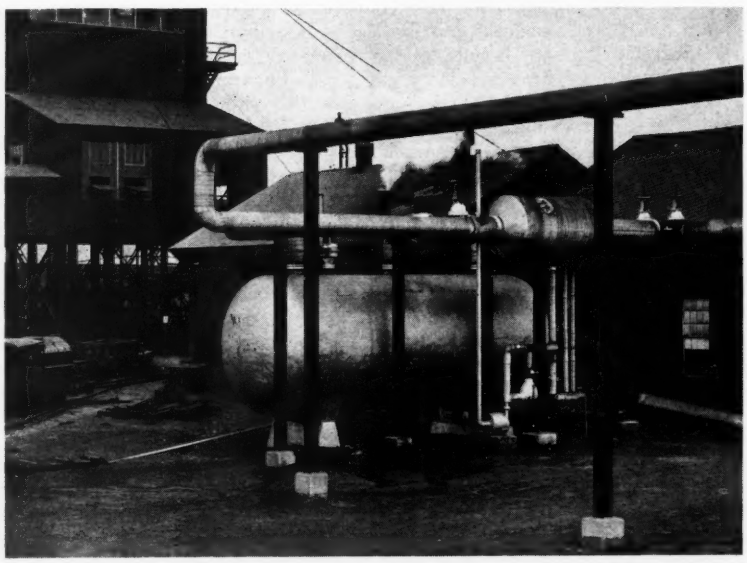
For a single engine the operating cycle of about 36 sec. consists of: An acceleration period of about 9 sec. during which the hoist is brought up to speed and when the engine steam demand may reach a rate of about 75,000 lb. per hr.; a constant speed period of about 10 sec., when the engine steam demand is reduced to a rate of about 33,000 lb. per hr.; and a decelerating period of about 17 sec. while the hoist is brought to the landing and the cars changed and when no steam flows to the hoist engine.

Engines Operate Independently

Both engines operate independently and on about the same cycle, without synchronization. It is possible, therefore, that both engines may be started simultaneously, several times an hour, and create a steam demand at a rate of approximately 150,000 lb. per hr.

The long pipe line between the power house and engines is large enough to permit satisfactory operation but such operation imposes severe peaks on the boilers. With the installation of the steam accumulator adjacent to the engine house, however, the peak steam demands are furnished by the accumulator instead of directly from the boiler plant, thus evening out the boiler load and eliminating disturbances at the extraction turbine.

THE Mellon Institute was founded in 1913 and through applied research has developed or invented more than 650 new processes and products.



Low pressure Foster Wheeler steam accumulator alongside the engine house. The shell has a roller support at the far end to permit expansion. Steam enters the accumulator at the center and leaves at both ends through expansion loops. The separator in the steam line at the right removes water and also reduces the effect of engine pulsations

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

SOME DO AND SOME DON'T

IT is always a source of amazement to us to observe how different items we present in this section result in different reactions from the readers, particularly in the case of the Question and Answers Department. Often the publication of what we feel is an important or at least an interesting question evokes practically no response whatever, whereas some simple, relatively unimportant item that is presented as a matter of routine results in a veritable deluge of mail for weeks and months on end. An example of the latter was the "Work Schedule" question asked by one, J. M. of Newark, N. J., in the ante bellum days of August, 1939. It seemed a simple enough question but replies to it poured in for the better part of a year. J. M. was himself amazed at the response and never again will he have to wonder about devising work schedules—he could write a book on the subject now. On the other hand, take the even hundredth question asking how to plan a motor repair shop displayed prominently on page 83 of the February, last, issue; we thought that a rather stimulating sort of query, yet, to date we have not received even a single comment on it. Naturally we are curious to know the reason, if any, for this startling lack of response. It seems that almost anybody who had worked around a plant would have some ideas on this subject. What's wrong with the question? Is it too general, too open to argument or too much like the age old topic of what ten books one would take along on a lengthy journey into the wilderness though there never was any lack of discussion about that. Let's have your ideas on this. Maybe we can do something about it.

A. W. K.

CONTENTS

Engineers And What They Ain't 86
By One Who Isn't Either.

Water Treatment 89
pH—Its Meaning and Significance in Water Analysis.

For The Plant Electrician 90
Connections for Lighting Supply Feeds.
By Eugene George Key
Danger Signal for Freight Elevator Entrance.
By Merrill A. Radamaker
Storage Battery Room Explosion Hazards Corrected.
By Paul C. Ziemke
New Frequency Meter Weighs Only 8 Ounces

Questions And Answers 92
Reducing Noise in Heater
Spreading Van Stone Flanges
Three Phase Motor on Single Phase Current
Wants To Build a Transformer
S. O. S. from the Philippines
How Are Compressors Operated in Parallel?
Savings—Due to Capacitors
Moisture in Ammonia
Water Column Valves
How To Remove Boiler Scale

Letters And Comments 95
Youth Must Take Over
The Crucial Age
Suction Lift of Hot Water in a Reciprocating Pump
Pulverizer Pete's Puzzle Paddock
How The Missing Link Was Found
Cold Water Breaks Hot Slag

Variation of pH With Temperature 100

A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago, Ill.

ENGINEERS AND WHAT THEY AIN'T

BY ONE WHO ISN'T EITHER

FOR THOUSANDS of years the pyramids have jutted from the bosom of Egypt; monuments to an ancient engineering skill the "how" of which has still to be explained.

Years after that ancient age of gigantic rock piled on gigantic rock someone dug a ditch through the Isthmus of Suez, somebody else put a pinwheel on a box kite and hopped off the ground with it, still another harnessed electricity and a fourth gave

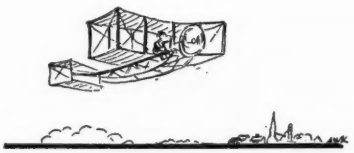
The Pyramids

us the low cost motor car. Thus, and the list is endless, is modern engineering represented.

When a civilized white man erects a heterogeneous conglomeration of cables, bars and girders to span a river his accomplishment is heralded as an engineering feat. A Pygmy of the Belgian Congo does the same thing with nothing save a lacy cobweb of vines and saplings and it is passed off as the product of ingenuity or instinct. But perhaps the native deserves the greater credit. He need consult no handbooks for the strength of his materials, he does not resort to mathematics to calculate the stresses in his structures, and has no steel beams that will support hundreds of times their own weight.

Modern civilization and its attendant inventions and developments is responsible for the glamourizing and publicizing of engineering. Switching on a electric light, driving a car, flying, riding a streamlined train, almost every action in daily life focuses attention upon contemporary engineering. And lest something escape the layman's eye, popular "scientific" magazines play up every detail of even the most insignificant contracting job.

Even the movies do their bit toward glorifying the profession and the men who follow it. Script writers continue to take unholy delight in sending their hero into some God-forsaken wilderness to build a bridge or dam across some valley (where it couldn't possibly be of any use) and to be "made" or "broken" in the task. There he fights tropical fever, avalanches, chilblains, earthquakes, native uprisings, wenches, and rum. Finally, his great work complete, the local dignitaries, marine corps, and a corps de ballet assemble. The bridge (or dam) is visible in the background silhouetted



Put a Pinwheel on a Box Kite

against a range of lofty peaks lifting their glistening snow-crowned heads to the caressing loveliness of the feathery clouds, all radiant in the light of the slowly sinking sun. (Painted canvas.) The hero is speaking: ". . . through all the weary, heart-rending years I have spent here working, fighting, hoping, there has been a spirit, a will, driving me on. All this (broad sweep of the arm) ——, whatever success I have attained, I owe to one woman." Applause, clinch, cut. Bunk!

Small wonder then that an enormous percentage of American youths of the quasi-innocent high school age decide to become engineers. Each dreams his own dreams; but the vision is nearly always the same. Soon he will stand high up on the edge of a precipice, dressed (as dictated by the movies) in campaign hat, high-cut boots, open-necked khaki shirt—a roll of blueprints under his arm. He will point here, there, give a few crisp orders and a bridge will spring up at his feet. The more serious perhaps think of revolutionary inventions or maybe they plan to become captains of industry and handle hundreds of men.

Woe unto him who graduateth from an engineering school hoping a hope like unto this, for such days hath passed!

For a time, when the profession was still a pampered infant, engineers did sail a more or less untroubled sea. Inventions, industrial expansion, a scarcity of technically trained men; all contributed toward an abundance of well paid positions. In those rosy days of 20 and 30 yr. ago industry would snap up engineers with the ink scarcely dry on their diplomas and they would be given positions from which they

At various times in the past 2 yr. we have presented articles in this section dealing with the general aspects of engineering as a profession—practical engineering in most cases. Most of these have been of the inspirational type, tending to emphasize the virtues of being an engineer. Here, we present another article on engineering, one which does not paint so rosy a picture and somewhat negative in its appraisal of the profession. It may be dynamite and there may be many who do not agree, yet there is much truth in what the author says and, though iconoclastic, the article, in our opinion, is a valuable one. It is well for us to look at things as they are and not kid ourselves with romantic nonsense that only breeds disappointment in the end. If engineering is not what novelists and scenario writers like to make it, it has other virtues, and if we recognize these virtues for what they are, perhaps we can be more satisfied in the profession. Anyway, the subject is open for discussion. If you differ with the opinions and conclusions of the author, let us hear from you. The author is an engineer, but as he puts it "personally has no axe to grind" since he has gotten away somewhat from slipstick pushing.

might, in the reasonably short time of 10 or 15 yr., work up to the point where they would be given the job of putting up a bridge some place. Those men had to be everything from mechanics to surveyors and the varied nature of their work trained them for the jobs that brought them prominence in the eyes of the public who read the pseudo-scientific newspaper accounts of their achievements.

Two factors have developed that have taken the romance out of engineering. One is the necessity, from the standpoint of efficiency, for an employer to make his employees specialize in a particular phase of his business. The other is the super-sufficiency of engineers for the amount of work available. Of course, there are always a few "jobs at the top" but these are obviously few and even when business is on the upswing their number seldom increases; while that of the average engineering positions invariably does. Hence, it seems that if an article of this nature is to present a true cross section of engineering it must deal with the "run of the mine job."

When industrial employers began to notice that they could be choosey about their technical help they began paying more and more attention to specialization, that is, developing an employee's potential abilities along the lines for which he displays the greatest aptitude. To further their purpose they instituted various systems of post-graduate education for their new men. These are usually known as cadet, student, or apprentice engineering courses and all are much alike in that they serve to instill in the "student" a fairly good conception of all ends of the concern's activities and at the same time determine for which he is best suited. They are also alike in that the pay is

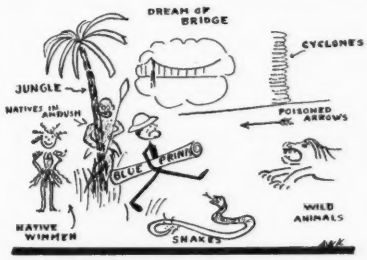
The Low Cost Motor Car

always low, ranging, generally, between $100 and $125 per month.

All of this simmers down to the salient fact that a young chap graduating from a technical school these days will not be given a job that will "make or break" him and if he gets anything at all in the engineering field the chances are a 100 to 1 it will be an opportunity to take a cadet course. But a college degree is by no means an "open sesame" to such a training course. Employers make these classes just large enough to account for normal personnel turnover (very small before the present defense boom), expansion (practically nil in recent years) and loss of employees through death or retirement. When all these contingencies are taken into consideration the result is still a surprisingly small number of cadets per yearly class and since the 1929 depression several years have elapsed in which most of the major industrial concerns did not form any classes at all.

When a cadet starts to work he will be assigned to some department in his organization—perhaps the shops, perhaps the drafting room—but never sales; for the foremost purpose of a training course is the making of a junior sales engineer who knows how to sell. Also, it is the hope of the employer that he will crystallize out of his collection of fry from the universities, technical institutes, and other hatcheries some new research men who know what to look for, designers who know what to plan, and service men who know how to fix things.

Eventually the young engineer learns that he is not necessarily going to end up in the department he hopes to. If the employer finds that a man is particularly good at the drawing board, for instance, he is very likely

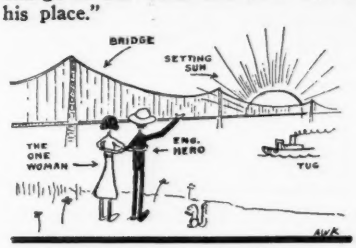


Send Their Hero to the Wilderness

to be kept there; or else—and the else is resignation. Other men who have the ambition to become sales engineers may prove to have anything but a sales personality. There isn't a chance in the world of these chaps ever getting an opportunity to try peddling their concern's product be it boilers or beanpoles. If they show talent along some other lines of the business they'll be put on some job where there are no outside contacts; otherwise—out.

There are many blind alleys for the young technical man with a large corporation to wander into today. After he has satisfactorily completed his student course, which may take from a year to 18 months, he will probably be allowed to sit around a few weeks with nothing to do but wait for an assignment. Then one day he'll be called into a minor executive conference.

Mr. "Q", says the "biggest shot" present, "old Mr. X has passed away (resigned, won a sweepstake prize—take your choice, reader, it makes no difference. Mr. Q is in their clutches), and we feel you are the man to take charge of our 'such and such' test in his place."



All This I Owe to One Woman

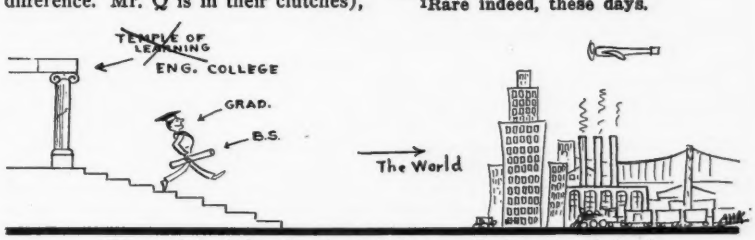
The 'take charge of' is the honeyed "coup de grace" and 9 out of 10 cadets, somewhat disheartened by the long period of training at low pay, lap it up little realizing that they are clamping the lid on the coffin of their career.

The "new job" brings with it a little raise in pay, a private office with the cadet's, pardon it's engineer now, name on the door and a few assistants, usually in the skilled labor class. In 6 months the "engineer" will discover that he has learned all there is to know about the test he is "in charge of". And in 6 yr. he will be "in charge of" the same test, probably conducted in the same manner, and probably at the same rate of pay.

If the same "engineer" then tries to get into some other branch of the business he'll be told that he is valuable where he is and that his employer will "look after him." The truth of the matter is that the science and methods involved in his company's business will have advanced leaving him behind and that he wasn't thought capable of anything but a routine job in the first place. It might also be hinted that his company needed a sucker and found, or rather made, one.

The drafting board is another cul de sac in which a cadet may find himself. Good fast draftsmen are rare[1] and if a youngster shows up well on the 'board' he has a good chance of being kept there. He will be decorated with the title of designer but he'll do little designing for the older, more experienced men will tell him what to draw. The greatest hope he can cherish after several years of this glorified mechanical drawing, is to become a chief draftsman, which merely means he will occupy the same position with respect to the other draftsmen as does a principal to a group of school teachers and in addition he becomes the recipient of all the executive h--l aimed at the drafting room.

[1]Rare indeed, these days.



Woe to Him Who Graduateth from an Engineering School

There are many such pigeon holes in the various divisions of an industrial concern and once an engineer slips into one he seldom has any alternative but to like it or try to find himself another position.

Mr. "Q" Says the Biggest Shot Present

If we were to follow the course of a more fortunate cadet, one who escaped being put on the shelf, we would eventually see him as an engineer in one of the major departments of his concern. If it were sales it would probably be the best for him for sales engineers usually come out ahead financially as most employers pay a bonus for sales above a certain quota. But selling is quite alien to his youthful conception of engineering so let us picture him in the design department of an electric motor manufacturer.

There he soon learns that standardization of products has also done much to take the "kick" out of engineering. Suppose a builder of washing machines, or even trolley cars, writes to this manufacturer requesting a quotation on an electric motor that will do this, that and the other thing under certain conditions. Does that unleash a crew of slide rule wielding engineers who feverishly calculate torques, ampere turns, shaft diameters, and what not, until a motor blossoms from the drawing board? Seldom! In 9 cases out of 10 the desired motor is a standard product and our "engineer" finds that it is necessary only to thumb through a few charts to find the selling price of a motor having the desired starting characteristics, speed, and power; and the prospect can be quoted within an hour after the receipt of his request.

Cadet, is this your idea of engineering?

The above is, perhaps, an extreme example but even proposal drawings for large steam boilers as tall as a seven story building are usually traced from standard templates that are jiggled about until they fit in the plan of the prospective customer's building.

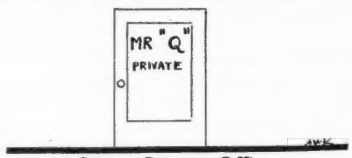
Occasionally, of course, jobs do arise where original designs are necessary and where basic principles must be applied; but there will not be an opportunity for the young engineer to shine for he will not come in contact with them except on minor details such as the computation of weights and stresses. An older, more widely experienced man will do the responsible designing.

There are two loop holes in the preceding remarks about "standardization" and "older, more widely experienced men" that some more aggressive young lads would immediately start poking into with:

"Why can't I be in the department where the standards are established?" or, "Why won't I in time be one of the 'older, more experienced men' and do some designing?"

The comeback to the first is simple. They can; but their chances of doing anything outstanding are no greater there than in any other department. Standardization, research, and development of new methods of calculation and production are closely allied but no individual is in a position to do anything startling because he cannot have his finger in enough pies. In other words, science has advanced with such tremendous strides that no normal person can become an authority on more than a few intimately related subjects.

The answer to the hypothetical cadet's second question is a little less obvious. In every well established industry there are still some men who have grown up with it and who have had their hands in all its branches, not because it was an efficient way to operate but because there weren't enough trained men available to permit anyone to specialize. These are the older more experienced men who are doing the actual designing today. A great many of their ranks are the vice-presidents in charge of engineering, chief engineers, and other executives who will probably remain active for



Gets a Private Office

some 15 or 20 yr., assuming that the retirement age is between 65 and 70. By the time the various industries lose these men they will have developed, judging from present trends, specialists on all phases of science and art pertinent to their field. Then, and this is not too rash a prophecy, the day of the omnipotent executive in charge of engineering will be done and in his place will be a committee of specialists who will decide upon the course to be steered. This must be regarded as more than a mild hallucination for already many large corporations have committees on design problems, standardization, research, marketing, and production methods. Definitely the accent is on group government rather than dictatorship and the reign of the chief engineer who alone may specify a complete design is passing.

Naturally, there must be a co-ordinator or referee to help such a committee over deadlocks, but he need not be an engineer any more than is a supreme court judge presiding over a patent suit; for like the judge he will base his decisions upon what he is told by experts.

A contemporary cadet, if he is hard-working and intelligent, has a perfectly good chance of finding a berth on such an advisory group; but again let us ask him: "Is this what you expected to find in engineering?"

In all fairness let us consider briefly the modern Alger hero, a junior engineer who becomes in a few years, assistant chief engineer of a progressive company. Does that mean he'll be the next chief? Very unlikely. The odds against him are about the same as they would be in the Cuban lottery, simply because the board of directors or other ruling potentates will bring in some older outsider with more diversified experience to prepare for the chief's place if there is the slightest concern about his health or the possibility of his retiring. When the outsiders are gone so will be the job of chief engineer as defined by present examples.

"But," squawk a multitude of would-be Goethals, Roeblings and whonots: "All this refers to office and laboratory jobs."

"I'm going into the erection department."

"I'm taking a foreign position."

"I'm entering service work."

All right, cadet, if that is your idea of engineering, if you have spent 4 yr. in college to become a mechanic, if you want to spend your days putting together the pieces that someone else has fabricated. Enter the erection department if you must; and you'll be like a kid playing with a mechano set. You'll handle men sure, but it will be a foreman's job no different than bossing gardeners or girls in a stocking factory . . . and maybe you'll think $3000 a yr. is good pay for working 40 hr. at a stretch when you're 50. Remember though, you must put together the pieces of a bridge the way they were built, you can't go trying out your pet ideas.

You might even get a superintendent's job for your trouble and that would mean that you would spend 70 percent of every day arguing with dissatified union delegates.

Service work is quite similar. For the most part it comprises fixing what the erection department installed incorrectly, or righting the bulls made on the drafting board and an estimate of its trials and tribulations may be gleaned from what has been said about erection.

Marry the Bosses Daughter

Obviously there are times when young engineers distinguish themselves by a clever bit of work in the field, but to hope for that is like joining a police force with the idea of becoming an individual hero.

Foreign work, because of the proportionately higher rate of pay, has always attracted a number of college seniors, but few realize the hardship

and futility of it all. The positions offered are usually on the basis of a 3 yr. contract with a 6 mo. vacation and a vague, very vague, promise of a home office job at the end of the term. The vacation is a tangible item and invariably materializes. Not so, however, the home office job; for when the time for it arrives, the engineer will be told to go back to grubbing copper out of the Andes or peddling "oil for the lamps of China," otherwise someone else will. It should be said, however, that most organizations are beginning to advise applicants that the contract does not imply an offer of American work after its expiration.

Today if an engineer decides to "go foreign" he had best make up his mind to stay that way. It might also be added that foreign positions are no longer paying what they did during this country's richer years.

So, as one engineer to a flock of hopefuls; if you want one of the few "jobs at top" marry the president's daughter.

If you're satisfied to push a slipstick many weary miles and spend years at routine calculations or tests for moderate pay you can carve a reasonably secure niche in a pleasant field. But don't expect to cover yourself with glory.

WATER TREATMENT

pH—Its Meaning and Significance in Water Analysis

THE TERM pH value is one that appears frequently in modern discussions of feedwater treatment. Most engineers are perfectly familiar with the meaning of this term, but for those who do not understand it fully, the following discussion, which appeared recently in an issue of the Betz Indicator and which is reproduced here by special permission of W. H. and L. D. Betz, should be of value. In conjunction with the chart on page 100 it presents a very clear description of the meaning of the term.

Water exists in one of three possible conditions. It is either acid, neutral or alkaline. A water that is either extremely acid or alkaline is unsuited for boiler feed purposes. Water which is most suitable is either neutral or only very slightly acid or alkaline, the latter being preferable.

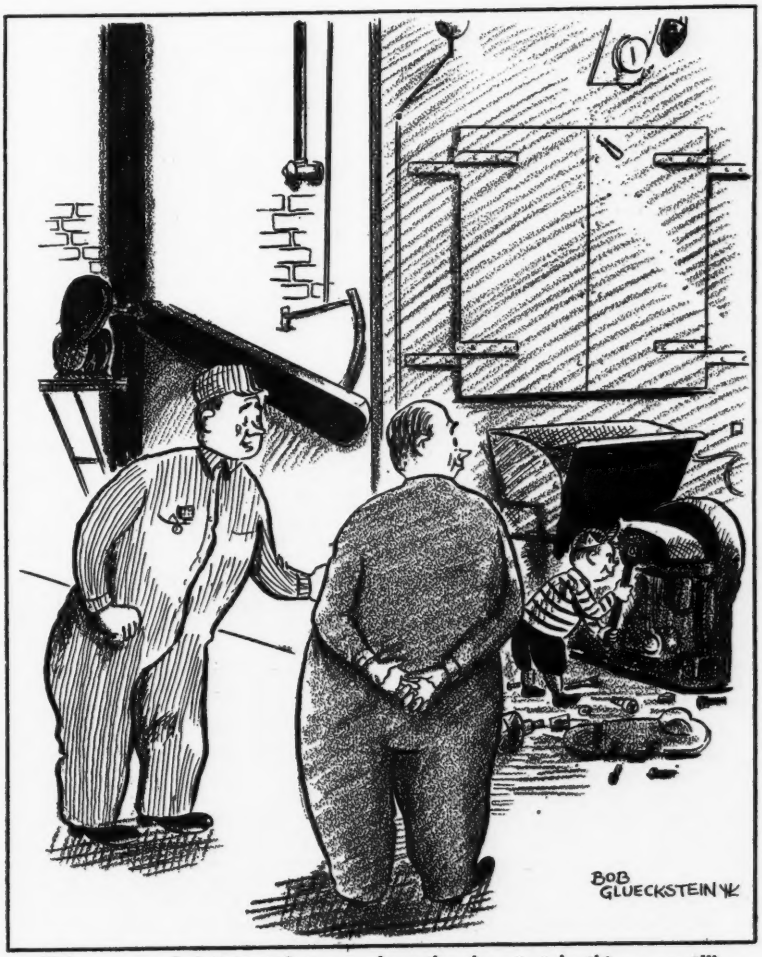
Whether a water is acid, neutral or alkaline is determined by its pH value, which really means Hydrogen Ion Concentration. True pH values indicate the hydrogen or hydroxyl ions that are liberated in solution, and are a measure of the intensity or degree of acidity or alkalinity. If the solution is acid, hydrogen ions will be liberated and the greater the acidity, the greater the number of hydrogen ions liberated if the same acid is present. One acid of a definite strength may liberate a greater number of hydrogen ions (H^+) than a different acid of the same strength. If the solution is alkaline, then hydroxyl (OH^-) will be liberated and, as in the case of the acid solution, the greater the alkalinity the greater the number of hydoxyl ions liberated, provided the same salt producing alkalinity is present.

To explain this point further, suppose we were to make solutions of 3 different acids and make them so that their respective strengths were exactly the same by analytical methods. Suppose further, the 3 acids we used in making these solutions were boric acid, acetic acid and sulfuric acid. Boric acid is a very weak acid, in fact, we can wash our eyes with it without discomfort. The acetic acid would be much too strong to use for washing our eyes, but not too strong to be taken internally. Vinegar is largely acetic acid. The sulfuric acid will be found much too strong to use on our eyes or to use internally. There is a vast difference in these solutions, despite the fact that they were made up of equal strength by analytical methods. The difference in these solutions will be found on the ability of the various acids to liberate different amounts of hydrogen ions. The more hydrogen ions that are liberated from an acid, the "stronger" it becomes. Thus, from the foregoing example, we can readily understand that boric acid liberates comparatively few hydrogen ions, while sulfuric acid, a "stronger" acid, liberates a far greater number. The measurement of the amount of hydrogen ions in a solution is termed pH value; this measurement provides a means of expressing the results in a numerical manner which can be readily understood.

Pure water (we refer here to chemically pure water composed of two parts of hydrogen and one part of oxygen by volume, H_2O) peculiarly does not split down into H, hydrogen ions and O, oxygen ions, but into H^+ (hydrogen) ions and OH^- (hydroxyl) ions, thus:

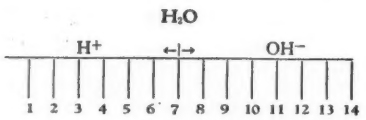
$$H_2O = H^+ + OH^-$$

By very careful measurements, it has been found that when pure water breaks down in this manner .0000001 grams of ionizable hydrogen are liberated per liter. This is a long incon-



"It's my son—he's just at that age where they love to take things apart!"

venient number to write each time, so it has been shortened by arithmetical process, and is written pH 7. Notice that the 1 in the above number is in the seventh place removed from the decimal point. This number (.0000001) can also be written 1×10^{-7}. Therefore the definition of the numerical method of expressing pH value is: pH is the negative logarithm to the base 10 of the hydrogen ion concentration, or in other words, expressed as the logarithm of the reciprocal of the hydrogen ion concentration. It is thus seen that absolutely pure water, which is neutral has a pH value of 7. The following diagram will serve to express this more clearly.



From the foregoing, we readily see that on the pH scale a pH value of 7 is exactly neutral. The further we proceed to the left and the closer we approach the pH value of 1, the greater the number of hydrogen ions released and the stronger the acid. The further we proceed to the right and the closer we approach the pH value of 14, the greater the number of hydroxyl ions released and the stronger alkaline our solution becomes.

It might be well at this time, to point out that the further we proceed in either direction from the neutral point of 7, the greater the concentration of hydrogen or hydroxyl ions, but not in direct arithmetical proportion to the distance between each number. To make this clearer, recall that a pH value of 7, means .0000001 grams of ionizable hydrogen were liberated per liter. A pH value of 6, would mean .000001 grams of ionizable hydrogen per liter, were liberated, or 10 times the amount liberated at a pH of 7. In a similar manner, a pH value of 5 will indicate 10 times the number of hydrogen ions liberated that will be liberated at a pH value of 6 and 100 times the number that will be liberated at pH value of 7. In short, each number on the pH scale, means 10 times the concentration of hydrogen or hydroxyl ions to the number to its right or left, as the case may be. The following table will serve to clarify this point further—

pH	H-ion Concentration— gr. Ionizable H per liter	
0.0	1.0	10^{-0}
1.0	0.1	10^{-1}
2.0	0.01	10^{-2}
3.0	0.001	10^{-3}
4.0	0.0001	10^{-4}
5.0	0.00001	10^{-5}
6.0	0.000001	10^{-6}
7.0	0.0000001	10^{-7}
8.0	0.00000001	10^{-8}
9.0	0.000000001	10^{-9}
10.0	0.0000000001	10^{-10}
11.0	0.00000000001	10^{-11}
12.0	0.000000000001	10^{-12}
13.0	0.0000000000001	10^{-13}
14.0	0.00000000000001	10^{-14}

It will thus be seen that when we reach a pH value of 1 or 2, we will have reached the point of concentrated acid of a very strong series. The following table shows the pH value of some of the more common substances.

Table of Approximate pH Values

0.1 N. Hydrochloric Acid	1.1
0.1 N. Sulfuric Acid	1.2
0.1 N. Acetic Acid	2.9
0.1 N. Boric Acid	5.2
0.1 N. Sodium Bicarbonate	8.24
0.1 N. Sodium Metasilicate	12.6
0.1 N. Sodium Hydroxide	13.0
0.1 N. Potassium Hydroxide	13.0
Apples	2.9 to 3.3
White Bread	5.0 to 6.0
Butter	6.1 to 6.4
Corn	6.0 to 6.5
Eggs	7.6 to 8.0
Lemons	2.2 to 2.4
Cow's Milk	6.3 to 6.6
Soft Drink	2.0 to 4.0
Wines	2.8 to 3.8

FOR THE PLANT ELECTRICIAN

Connections for Lighting Supply Feeds

By Eugene George Key

AT VARIOUS TIMES in the past, wiring and maintenance electricians have inquired into the methods of connecting feeds for lighting circuits from the supply transformer. The writer has been rather surprised to learn that, simple as these connections are, two college teachers—one a well known professor of electrical engineering—were unable to answer all the questions asked by these men.

There are three general ways that lighting feeds are brought in from the supply transformer: 1. the 2-wire Edison system, 2. the 3-wire Edison system, and 3. the unbalanced ground system from a 3-phase delta-connected transformer feeding both power and lighting circuits.

The 2-wire Edison system is familiar to every electrician and needs no further explanation. It is shown in Fig. 1 as feeding from the secondary of a lighting transformer. It is used only on small installations and, today, is nearly obsolete as a supply feed for new installations of any size.

The 3-wire Edison system, although more complicated than the 2-wire, is still simple enough not to occasion any alarm for those who work with it. This system was explained in some detail on pages 63 to 66 of the June, 1940, issue of POWER PLANT ENGINEERING in an article by the present writer called, "Calculations on the Three-Wire System." In Fig. 2 it is shown as feeding from a lighting transformer. It is used to supply all dwellings and buildings too large for the 2-wire system as well as large factories which have separate transformers for lighting and power feeds. It is rapidly replacing the 2-wire system even for small dwellings in large cities. From the main switchboards, of course, all lighting circuits are 2-wire.

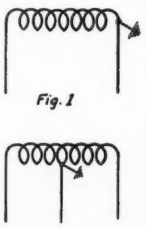


Fig. 1

Fig. 2

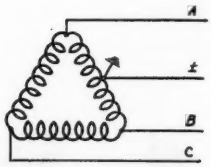


Fig. 3

The unbalanced ground system feeding from a 3-phase delta-connected transformer is the one that puzzles even those fairly familiar with it and even stumped those college instructors. Since it is used in all plants and factories not large enough to warrant a separate transformer bank for lighting feeds, it is quite a common connection. This bank of transformers is used for both power and lighting circuits. The connection is shown in Fig. 3.

In this figure, A, B, and C are the 3-phase power lines. The neutral wire is taken from the transformer between A and B phases, and lighting circuits are connected between A and neutral and B and neutral. Thus, A and B feed lighting as well as power loads, and, with the neutral wire, form a 3-wire Edison system.

Test equipment will always show a voltage between A and neutral equal to that between B and neutral. The voltage from C to the neutral wire is very much higher and this voltage should not be tested with a lamp whose rating is no higher than that from A to neutral. If this is done, the electrician may find his test lamp exploding in his face.

Actually, the voltage from C to the neutral wire is 1.732 times that from A to neutral or B to neutral. If the voltage from A to B, B to C, and C to A is 230 v., then from A to neutral or from B to neutral will be 115 v. From C to neutral, however, will be 199 v. This figure is, incidentally, 86.6 percent of the C-A, B-C, or A-B voltage. These values are approximate, and depend on the amount of current being fed on lines A, B, and C, but are within a few volts of the actual values under all conditions.

The unbalanced ground in this system increases the difficulty of locating accidental grounds on either the lighting or power circuits. Since this phase of the subject is beyond the scope of this article, it will be discussed at some time in the future in an article dealing with shooting trouble on an unbalanced ground system.

Danger Signal for Freight Elevator Entrance

By Merrill A. Radamaker

A SIMPLE and inexpensive danger signal is shown on the attached diagram, consisting of a (spring return position switch) located so that when either the magnetic (up) switch, or the magnetic (down) switch closes, the body of the magnetic switch will press against the push button of the spring return switch. It is possible with magnetic switches located far enough away from the face of the board to locate the push switch between the body of the magnetic switch and the face of the panel, so that it will push the button in, when the magnetic switch closes.

If the space between the magnetic switch and the face of the panel will not permit mounting the push switch in this location, the push switch can be mounted on the back of the control panel, a hole can be drilled through the panel to center up with the push button so that a round piece of fibre cut to the right length, and fitted in the hole so that it will move freely and press the push button.

Note on the diagram that when either the magnetic (up) or (down) switch closes, it causes the push switch to make contact, lighting either the up or down light, depending on which one of the magnetic switches operate, the diagram also shows the connection for the operation of single stroke, 24 v. bell. This bell is for the purpose of drawing attention to the lights, also indicating the instant the car starts at any location in the shaft, by giving only one stroke each time the car starts. When the car has stopped, the lights and bell are not in operation.

The diagram does not show the magnetic switch closing coils, or the control wiring from the car to the control board. I have shown the main wires to give some idea of the difficulty that would exist if attempting to connect this system in any other way.

With minor changes, this same system can be used on any alternating current elevator up to 440 v.

Storage Battery Room Explosion Hazards Corrected

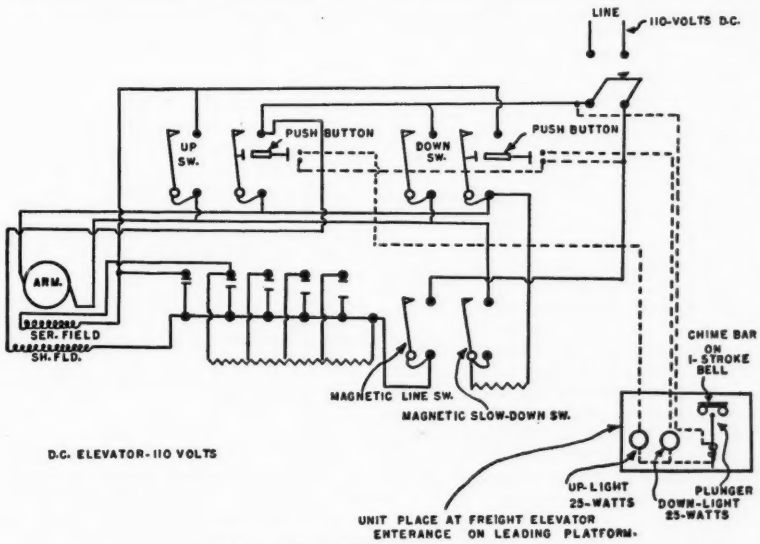
By Paul C. Ziemke

A FACT quite well known to most operating engineers is that unless some positive and reliable means is provided to change the air at regular intervals in storage battery rooms, dangerous accumulations of hydrogen gas may result.

Batteries off charge or merely "floating" on the line present no appreciable hazards since no gas is driven off, however, to ignore the situation because of the comparatively short charging is merely tempting fate. A painstaking study extending over a period of 4 yr. has recently been completed by the U. S. Bureau of Mines in which some 5000 samples of battery room air were analyzed. In all cases where the battery was on float no appreciable quantities of gas were detected, yet there were instances found where the highest average concentration of gas tested was 5.35 percent, and this is obviously in the explosive range.

Leaving really nothing to chance, we installed an electrically powered ventilating system in our battery room at the time of the original construction. The two ¼ hp. fans are mounted in the windows and rotated so that one is exhausting while the other is drawing in fresh air. Conveniently located switches enable the attendant to reverse the process when adverse winds prevail. In addition, precaution was taken to insure positive fan action, by using the charging current as a power supply with an auxiliary arrangement provided for those rare instances when high summer temperatures require the operation of the ventilating system during non-charging periods.

By using the charging current to drive the fans, forgetting them is eliminated, and on the other hand they automatically cease to run when the charging operation is completed, thereby insuring a safe battery room at all times, both, as health for the attendant and the explosion hazard.



Wiring diagram for Elevator Danger Signal

New Frequency Meter Weighs Only 8 Ounces

THIS SMALL frequency meter, weighing only 8 oz. is a recent development of the Westinghouse Electric and Mfg. Co. No larger than an engineer's slide rule, it will indicate frequencies between 500 and 20,000 cycles per min. in a vibrating body.

This compact device is built around the principle of the vibrating reed and consists of a thin spring steel vibrator clamped at one end between a set of steel rollers. A knurled knob connected

Frequency Meter

to the rollers permits their rotation and moves the steel reed in and out, changing its frequency of vibration. A sliding pointer on the back end of the steel reed indicates the vibrating frequency which is read off the calibrated scale on the frame of the instrument.

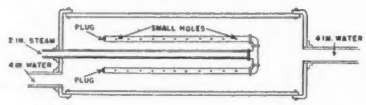
To use the meter, its head is held against the vibrating body and the adjusting knob rotated until the vibrator reed moves to and fro at maximum amplitude. If more than one vibrating frequency exists, there will be a point of maximum amplitude for each, and vibrations in differing planes may be detected by changing the axis of the meter. The meter is very sensitive. It will indicate a vibration whose double amplitude is one ten-thousandth of an inch or greater. It can measure harmonics of basic vibration frequencies. Although not designed to measure the amount of vibration, it may be used as a rough indicator of its magnitude.

Questions And Answers

109

Reducing Noise in Heater

Q. We have a 72 in. by 20 ft. cylindrical steel water heater arranged with perforated steam pipes inside as shown in the accompanying illustration. The



noise made by the heater is very annoying and we should like to have suggestions from readers as to how this noise might be reduced.

New Britain, Conn. P. G.

110

Spreading Van Stone Flanges

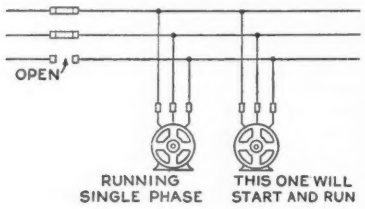
Q. What is the best way to spread a Van Stone flange to install a new gasket? Any information on this will be appreciated.

Orange, N. J. Wm. Deeley.

A. 94

Three Phase Motor on Single Phase Current

On page 77 of the January issue R. F. asks if it is possible for a 3-phase motor to start with one phase open (one fuse out). It seems to me that the answer, while correct, might not give R. F. the answer he wanted. If a 3-phase motor is running off a circuit with other



3-phase motors as sketched, and one fuse blows while the motors are running, under proper conditions of comparative size and load, other 3-phase motors will start and run. The 3-phase current being generated by the running motor or motors (running single phase). The unbalance is something else but the fact remains that the motor or motors will operate and make a hard case of trouble to find.

Carlsbad, N. M. E. A. Roberts.

111

Wants to Build a Transformer

Q. I wish to construct a transformer for operation on 110 v. a.c. The secondary should deliver a current of 40 amp. at 4 v. Would someone kindly advise me what size core to use and how to proportion the size of wire and the number of turns in the primary and secondary?

W. B. Laughinghouse.

New York, N. Y.

A. 86

S. O. S. From the Philippines

A. In answer to the S. O. S. from the Philippine Islands, in the January 1941 issue.

About one of the simplest of all hook-ups that I have ever had the occasion to witness in operation, consisted of a General Electric Co. type PB-58, that was operated by the differential relays in the generator leads. This PB-58 relay then in turn operates the main oil circuit breaker, the ground neutral breaker, the generator field breaker, and the solenoid that trips closed the main throttle valve of the turbine.

The above hook-up all operates together the instant that trouble occurs in the system, and it can be installed by the average plant electrician. It will require but little attention, once it is properly set up for the conditions required of it.

I might also say that the PB-58 has a small switch on it that serves to cut off the current to the differential relay, and when the PB-58 relay is reset for normal operation, this circuit is restored to the differential relay, providing the trouble has been removed from the system.

Paul F. Dickens, Sr.

Quanah, Texas

In answer to S. O. S. from the Philippines in your January 1941 issue:

Install a current transformer in the neutral resistor circuit. In the secondary, connect a CO relay or instantaneous relay set slightly below safe carrying capacity of resistor. The relay could either give an alarm or trip the neutral breaker.

It would seem to me that ground relays either low energy CO or CR should be provided for the 13.2 kv. ties and feeders. This would provide fast clearing of ground faults. On our system (West Penn Power Co., Pittsburgh, Pa.) the 25 kv. system is grounded through several resistors scattered over the system. We use low energy CO and CR relays in all ties and feeders and a signal and recording ammeter on all resistors. So far as I know we have never burnt up a resistor.

At one power plant, a current transformer in the neutral resistor circuit connected to a thermal relay (General Electric Co. Type TC 211A10) closes a breaker to short out the resistor. This, of course, increases the fault current and should cause the phase relays to operate.

Harrell Denmean,
System Operating Engineer
West Penn Power Co.
Pittsburgh, Pa.

A. 87

How Are Compressors Operated in Parallel?

A. In answer to M.B.'s question on compressors in the January issue:

Two single stage compressors can be operated satisfactorily in parallel but the unloaders should be set exactly the same or near as possible. If there is difference in the differentials of the two sets of unloaders, then one will operate at full load and the other one will cut in and out. Of course this operation will not do any harm in any way, but if it is desired to make the compressors carry full load, the best way is to reduce the speed of the compressors so as to just maintain the desired pressure. In this way even though one does cut in and out now and then, both will be delivering near full load. If the load is constant, this can be done, but if the load is fluctuating, then the speed of the compressors must be high enough to maintain the maximum demand and when the load drops, the operation will be as first stated. If it is found that one compressor does all of the cutting in and out, then periodically change the unloaders around so as to produce the opposite results.

Chas. W. Parks.

Baltimore, Md.

A. Assuming that M.B. is referring to air compressors I would say there are only two ways of hooking these compressors up in parallel. One of these ways is as his engineer states, that is by hooking up the unloaders

together so that both machines cut in and out at the same time. The other way is to hook up the unloaders so that they can be changed over from one machine to the other by opening and closing the necessary valves. Then set the unloaders so that one compressor will take the load and the other will cut in only when the first compressor will not handle the load. Each day change over the unloaders so that the same compressor does not carry the load all the time.

I cannot help but feel that there is more to M.B.'s problem than just hooking up two compressors in parallel and as he did not say why he wished to do this, I would advise him to check over his air system before making any changes in his present setup. If he wishes to parallel the two compressors because of a steady overload his best bet is to hook them up as the engineer suggested and install a larger receiver or purchase a new unit large enough to handle the load. But if one compressor will handle the load except for an occasional overload he should get good results by hooking them up the other way that I suggested.

DONALD OSTERHAUDT.
Poughkeepsie, N. Y.

A. For the information of M.B. who inquires about running air compressors in parallel please advise him that it is standard practice in all large mines, etc. I once operated three, 2000 c.f.m. Ingersoll-Rand units powered by three 600 hp. synchronous motors and experienced but limited difficulty in keeping all units working in step. I suggest he consult with the manufacturer who can easily advise if needed for parallel operation.

PAUL C. ZIEMKE.
Milwaukee, Wis.

112

Savings Due to Capacitors

Q. I am confronted with a problem in power factor correction on which I would like to have some information. It is my intention to install capacitors to bring the power factor up to the desired point.
This is the data:

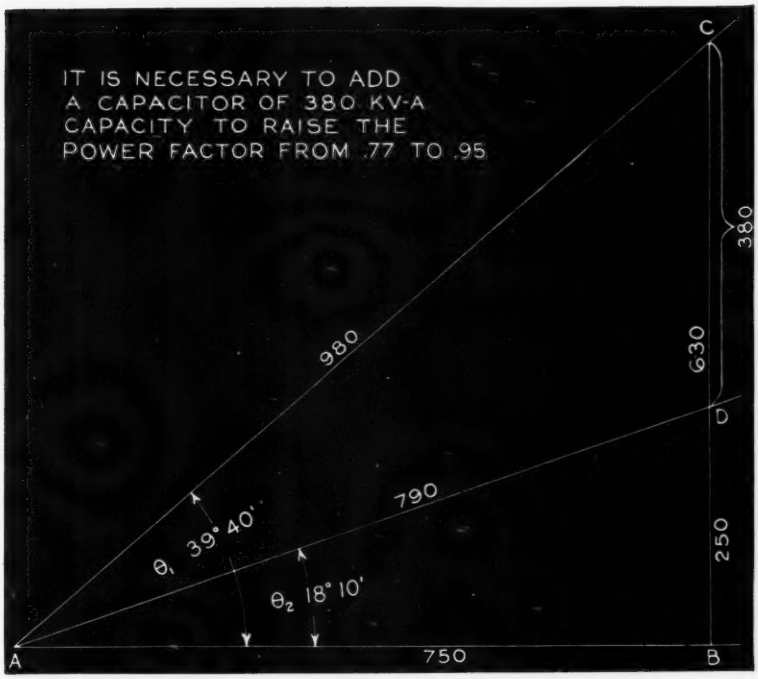
Present: 750 kw., Power factor 77 percent, 1400 amp.
Desired: 750 kw., Power factor 95 percent, 1120 amp.

Kindly explain what savings in generator energy or percent reduction in cost would result from the installation of capacitors to meet the above conditions and show just how you arrive at your solution.

WALTER SCHMIDT.
Kankakee, Ill.

A. Your problem is most easily solved graphically, although the solution can be arrived at by straight trigonometrical calculation as well.

The graphical solution is shown in the accompanying diagram. With an energy load of 750 kw. you wish to raise your power factor from a present value of 77 percent to a desired value of 95 percent.



The 750 kw. energy load is represented by the base line A-B, drawn to scale. With a power factor of 77 percent the kv-a. under these is represented by the line A-C. Since the power factor is the cos. of the phase angle, the angle θ_1 is the angle corresponding to a cos. of .77. From trigonometric tables this is shown to be 39 deg. 40 min. Thus the line A-C is drawn at an angle of 39 deg. 40 min. to the base line A-B. The point C is determined by the intersection of the line A-C with the vertical line B-C erected at B. The length of A-C by measurement is found to be 980 kv-a.

The reactive current or the magnetizing current as it is called is represented by the line B-C. This measures 630 kv-a.

The kv-a. corresponding to the desired power factor of 95 percent is determined in a similar manner and in the diagram is represented by the line A-D. In this case the angle θ_2 corresponding to the cos. 95 from trigonometric tables is found to be 18 deg. 20 min. Hence the line A-D is drawn at an angle of 18 deg. 20 min. to the base A-B and the point where this line intersects B-C is labeled D. By measurement the length of A-D is found to be 790 kv-a. This corresponds to a magnetizing component of 250 kv-a.

Thus to increase the power factor from a value of 77 percent to the desired value of 95 percent it is necessary to supply leading reactive current equal to 630—250 or 380 kv-a. In other words, a capacitor of 380 kv-a. is necessary.

So much for the determination of capacitor size. This, as you see, is simple and definite. The savings involved in installing such a capacitor are, of course, dependent upon a number of conditions which are not mentioned in your letter. For example, your present cost of power and the degree to which your present generating unit is loaded. The magnetizing current, it must be understood, is a wattless current, that is, it does no useful work. It surges back and forth between the generator and the magnetic fields of inductive apparatus and is not charged for in the ordinary sense of the word. This current does, however, produce a heating effect as it flows through the line and each ampere of magnetizing current detracts just that much from the possible load current a given circuit can carry. In other words, the magnetizing current limits the capacity of the generator.

If your present system is not loaded to its full rated capacity, the magnetizing current obviously has little effect upon the cost of power except that by virtue of the greater IR drop the efficiency of the system may be somewhat lower. Suppose, however, that the system is loaded up to its full capacity and that in addition you were compelled to purchase outside power to the extent of 380 kv-a. Then, by the installation of the 380 kv-a. capacitor you would save the entire cost of the 380 kv-a. since the capacitor would so reduce the load on your generator that it could supply all the power.

Or, suppose you are buying all your power but that the power contract has in it a power factor clause which penalizes you for a power factor lower than, say, 95 percent. Then the installation of the capacitor would completely wipe out the penalty.

So you see the savings effected by the installation of a capacitor are en-

tirely dependent upon the conditions under which you generate your power or at the rate at which you buy current. In the absence of any specific data regarding costs it is impossible to tell you exactly how much the installation of this capacitor will save, but we believe that we have given you enough information on the general method involved so that you can determine the savings for yourself. Of course, against the savings effected by the reduction of power factor or the removal of a penalty clause in your contract must be balanced the investment charges on the installation of the capacitor. Once installed, however, a capacitor requires relatively little maintenance and most of the charges are in connection with the original cost of the capacitor.

A. 88

Moisture in Ammonia

A. In answer to H.T.'s problem on moisture in ammonia, on p. 76 of the January issue, if moisture is thought to be present in the system, draw a small sample from the bottom of the receiver in test tube. Place near a warm object, such as a steam pipe and allow the ammonia to evaporate and the water will be left in the test tube. Take the percentage of water left in the tube, of the original sample, and the result will be the amount of or percentage of water in the system. Water can be drawn off from the system from the drains on the low pressure side of the system. The best time to draw the water is when the system is warm after the defrosting period at which time you can be assured that none of the moisture will freeze in the pipes. If the ammonia contains a considerable amount of water, brine or other liquids such as oil, the best thing to do is to have the entire charge distilled. Most dealers of ammonia are willing to co-operate with the customer in troubles of this sort.

CHAS. W. PARKS.

Baltimore, Md.

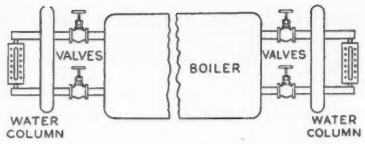
113

Water Column Valves

Q. Have you any information about valves being installed between boilers and water columns on high pressure boilers? I have always understood that boiler laws prevented such an installation.

Chicago, Ill. E. P. Z.

A. There has been quite some discussion and argument as to whether valves should be installed between the boiler and the water column. The A. S. M. E. boiler code states that any boiler having two complete water columns may be constructed with valves between the column and the boiler, not when only one water column assembly is in service on each boiler.



The argument centers around the safety of such an installation, of course where only a single column is installed on a boiler there would be no positive indication of the amount of water in a boiler, so the rule prohibiting valves between water column and boiler on a single water column installation has no counter argument.

However, in large boiler installations where two complete water columns are installed, the valves may be installed between the column and the boiler. But such an installation always has the possible danger that these valves would be closed and thus there would be no positive indication of the water level in the boiler.

It is true that water columns on high pressure boilers meet a much more rigorous service and consequently must be replaced or repaired more frequently than on a low pressure boiler, also, high pressure boilers will remain in service longer between boiler shutdowns. With this problem in mind we should say that valves placed on the water column would be very practical.

However, these same valves are a source of danger due to improper handling, and in order to correct this danger these valves should be locked in an open position with some system of chains and safety locks so that it would be impossible for anyone either accidentally or intentionally closing these valves and thus shutting off the water column. This should be intrusted to one person who retains the keys to these safety locks, and would then be the only one responsible, making for a much safer condition than where responsibility would be spread over several men.

A. 92

How to Remove Boiler Scale

A. In the January issue of Power Plant Engineering, Boyd Standofer asks about the removal of a boiler scale. According to the analysis submitted, this scale was over 87 percent combined carbonates of lime and magnesia; the balance was in the form of iron and silica. It is quite probable that the latter items represented material distributed uniformly or evenly throughout scale but not forming a part of the scale, existing rather as an adulterant and something which when the carbonates in the scale were disintegrated, would be mechanically removed at the same time. The removal of such a scale is not a difficult thing, assuming the operator understands clearly the dangers which might occur in connection with the chemicals required.

It is generally known that a carbonate scale can be dissolved completely by an acid. There are many acids available, but there are objections to the use of practically all save hydrochloric, sometimes spoken of as muriatic acid. This acid commercially appears in a concentration in the neighborhood of or slightly over 25 percent. That concentration is entirely too great for the purpose in question and it has to be greatly diluted. An acid like hydrochloric acid is more particularly selective and will dissolve anything with which it would come in contact unless something can be done to it to retard action. This action, unless something were done, would result in the corrosion of the iron where the two would be exposed due to less scale being present, and that danger retards a great many people from using acid.

There are quite a number of chemicals which can be used in varying quantities that retard the solvent action of acid in connection with iron. Many of them are hard to get, expensive, and of uncertain quality. It has, however, developed that carbon tetrachloride, which can be obtained cheaply and of a fairly uniform quality, is being used effectively in a general way where there is not a chance of close scientific supervision than any of the others. A quart of carbon tetrachloride to 5 gal. of muriatic acid represents perhaps a slightly excessive quantity for use but it will, if properly mixed, retard the corrosive action upon iron 90 to 95 percent.

This information must be qualified. There are a number of things that develop in connection with the use of any acid. There are problems developing in connection with the proper opening up of the system or the boiler, to carry out this solvent action, and although the chemicals specified above will do what we have suggested, it would be our firm recommendation that no engineer would try to carry out such a procedure for the first time without help. There are water engineers and there are well-known boiler compound companies which supply chemicals to accomplish this and the first treatment should be in the presence of some representative who has seen the job done before.

Before closing I would want to state that while much more is necessary, the proper combination of a tannin extract with hydrochloric acid will sometimes produce a better removal because during the period that the acid is dissolving the scale the organic tannins would be softening and disintegrating much that might not be completely dissolved.

I should be very glad to answer any specific questions in connection with this problem in case Mr. Standofer would wish to get in touch with me.

DUDLEY K. FRENCH.

Winnetka, Illinois.

LETTERS AND COMMENTS

Youth Must Take Over

SOME MEN will buy a new car and use it for 5 yr. and then trade it in, the fellow who buys his car inherits its troubles, if the car has been well taken care of he gets a bargain, but if it is not he gets a lot of headaches, so with power plants, it has been my experience to work in a power plant where the Chief Engineer was getting along in years, who ran a power plant so cheap that I feel sorry for the man who takes his place, nothing renewed if it could be patched up. In the course of 30 yr. of patching you can readily see what his successor would inherit. True he saved the company money or did he? This condition prevails more than is generally known and when a younger man takes over it is necessary for him to spend a large sum of money to put this same plant in shape which in turn causes the company to object or do away with their plant.

Youth must take over and it is no consolation to take over these broken down plants, but it is these plants that will give a young man experience if he has what it takes.

He will probably come in contact with some old timers who are just putting in day by day until they retire, or are old in body but young in mind who can and will, offer a lot of suggestions that are helpful. It is a well known fact that when a man dies he "Can't Take It With Him," yet some of these old timers who have a great deal of practical experience will pass along and take their ideas with them. How much better it would be for them to hand them over to some one who could use them. The young engineer meets up with problems that the old timer had already solved, in some cases they take quite a while to figure out, but if these things were kept in a permanent record they could be handed from "Chief" to "Chief" and save a lot of unnecessary work.

Such is the case of a great deal of power plants today and the young man who gets a "bargain" is indeed lucky, for he can after awhile, take up where the other fellow left off and try and obtain more efficiency which in turn conserves our natural resources which should be the first consideration of any engineer.

L. E. K.

The Crucial Age

IN THE January issue, Mr. Osterhoudt makes some interesting comments on my article, "The Crucial Age." I thank him for his interest. Although he classifies my effort as "feeble," it did get a rise out of him. That is something.

Let me hasten to assure Donald that the writer is no stooge for economic royalism, no disciple of intrenched greed. But he does claim to be a member of that fast vanishing variety of the Genus Homo Sapiens, "The Rugged Individualist."

We do believe that our worthy contemporary has missed the point of the article entirely. We shall therefore speak more plainly.

It was the writer's intention to illustrate the tendency that we men approaching middle age have to become narrow minded and bigoted, not only about our work, but about life in general. We readily open our minds to a dogmatic sort of thinking, which is all the more malicious because we are unaware of it. The writer agrees with his critic, in that older men know their work better. We readily admit that we have more knowledge now than at the age of twenty. That we are better men. But it is that very knowledge that is our undoing. Why should we hold that we have the last word in everything? Because we have always done a thing ONE way does that mean that there is only ONE way?

The writer holds no brief for the company that employs youth for what they are wont to term "economic reasons." We are sure that a respectable Journal like PPE would not print our comments on such practice.

On the other hand, we realize that the jelling of ideas, the setting of our ways, that is what seems to be the characteristics of the "Crucial Age." We are bound to lose ground if we accept life on those terms.

Because we are accustomed to the transmission of alternating current, shall we throw up our hands in horror at the very mention of doing the same thing with direct current? Are we going to say "impossible" at every attempt our scientists make to progress?

As we have accustomed ourselves to the economic theories of John Stuart Mill, Ricardo, Adam Smith, et al., shall we discard, without examination, the theories of Henry George?

To the writer, the basic difference between Greatness and Mediocrity is the difference of breadth of vision between the two.

If you cannot see manufacturing tolerances, in every day production, of "two-tenths," it is a positive sign that you will never get them. Men can do what they can imagine. It is the duty of every individual to seize upon every idea and wring from it every one of its most remote possibilities. Even such a feeble effort as this.

Me, I'm going ahead, damned if I ain't.

SAM WILLIAMS

REGARDING MR. PAWLOWSKI'S VIEWS

WHILE I HAVE too much sense to take personal offense at the remarks of Mr. Matthew Pawlowski in the February issue, I do take issue with him, purely in defense of those fine, generous golden hearted *Old Timers* who were of such great help to me.

Don't tell me that Dan H—, operating a shifting engine at the Troy yards did not know his business. Many hours, happy and fruitful, were spent on Dan's knee (literally) learning old "522" from headlight to drawbar. And, Dan let me run her, too. I suppose that Old Jerry H—, at the City Lighting plant, was also a nin-com-poop. Yeah. Jerry, who had spent 50 yr. at being an *engineer*, showed me a little about indicating an engine. "Now, Sam, when this valve releases—" I can hear him yet.

And of course the old German at the brewery was just an ignoramus, "Sam, vouldt you look at der ammonia as you vouldt look at der steam, only backwards—" and so on, for hours. Even though I was still in high school, Paul would try to teach me. God knows I did not deserve such expert attention. Many's the bucket of suds I downed with the aid of Old Paul. To my mother's horror, and my Dad's delight. Chip off the old block, you bet.

What book can show you how to clap a spanner onto a rapidly moving nut, and with a deft smack of a hammer, send it home? Many a time I've seen Cy, my first marine Chief, do that. And did I wet my britches when I first tried it. Sure had some visions of that spanner flying around the eccentrics. No, you just do not stop the boat while you consult some weighty tome.

Did you ever see a book that could teach you to synchronize an alternator to the bus, with the water in the penstocks surging, governors hunting, phones ringing wildly? George G— could do it. "Now, keep your head Sam. Cut out that low tension breaker, and use the

high side for phasing. It's a little faster in operation. And, don't close on a dead scope." Sorry, Matthew, those books have yet to be written.

I do not know what Mr. Pawlowski's experience has been, but I owe, and cannot pay, a tremendous debt to those Old Timers.

I have the finest library, in constant use, that money can buy. Everything from Steinmetz on electricity, through Timoshenko on materials, to industrial bacteriology, and if I were forced to a choice, I'd part with the whole damned caboodle of them, rather than lose what my old friends have shown me.

Old Timers, I salute you, for your courage, for your ambition, for your ingeniousness. And I, Old Timers, have no right to be proud of anything.

In closing, the writer hastens to remark that he is 100 percent opposed to licensing laws on the grounds that they would inject politics into the honorable field of engineering, and that he, as a free thinker and free trader to the ultimate degree objects to any organization, clique, circle or what have you interfering with his right to work as to when, where or how he pleases.

Do you suppose that Old "Bobby Burns" was by way of being an engineer, after the manner of Scotchmen the world over? "Oh, would the gift the Gods would give us, to see ourselves as others see us."

Wingdale, N. Y.

SAM WILLIAMS.

Suction Lift of Hot Water in a Reciprocating Pump

I WAS SOMEWHAT interested in what Mr. George Blum said about lifting hot water with a reciprocating pump in his article on page 95 of the December 1940 issue.

He would have you to understand that it is all a matter of atmospheric pressure and temperature of the water. There are other elements in this subject that are most important to know. What Mr. Blum says about lifting hot water anywhere near 34 ft. is absolutely true, but the truth is crowded so far from the sublime that it becomes ridiculous. Cold water cannot raise 34 ft. with the best of equipment. It is not considered practical to raise cold water with a lift pump more than 25 ft. The writer has been able to raise cold water in an emergency 27 ft. at 500 ft. above sea level, but I do not consider it practical. The slightest amount of irregularity about the pump would cause the prime to be lost which would not do at all in these days of automatic equipment. To get back to the hot water—the prime reason that hot water cannot be pumped is because of the vacuum in the pump cylinder. It is a well known fact that the boiling point of water varies in a rough way with pressure. For instance at atmospheric pressure water boils at 212 deg. F. and that would be atmospheric pressure of 14.7 lb., then at 19.0 lb. absolute pressure the boiling point would be 225.24 deg. F. and 24 lb. absolute pressure would be 237.82 etc. At any rate we notice that whenever the pressure goes up the boiling point goes up and on the other hand when the pressure goes down the boiling point goes down. For instance, at 10 lb. atmospheric pressure the boiling point is 193.21 deg. F. and for 5 lb. absolute pressure the boiling point is 162.24 deg., etc. So we must bear in mind that the boiling point ranges roughly with the pressure. When the pressure is up, the boiling point is up and when the pressure is down, the boiling point is down. Now then, with a reciprocating pump pulling on a low lift, suppose the pressure runs down to 5 lb. absolute, then the boiling point is 162.24 deg. F. When the water comes from a low hot well, the pressure in the pump chambers becomes so low that the water flashes into steam. Let us say that the feedwater was 210 deg. F. and it came to the pump where the pressure was only 5 lb. absolute and where the boiling point is 162.24 deg. F., the water flashes to steam at once and we say the pump is steam bound. The immediate remedy is to cool the pump and cool the suction water. The permanent repair is to put head into the suction line so that the water would show a pressure at any time exceeding slightly the corresponding temperature of the feedwater. Then it cannot boil and cause trouble. This is usually accomplished by setting the heater high above the pump. The writer supervised one plant where the heater was above the pump so that we had no trouble in pumping water at 212 deg. F. into the boiler. If anybody should check up on me they would find that so far as I have stated, my story would not hold, but I have yet to call attention to the fact that if the elevation is enough so that the water will flow into the pump chambers as fast as the piston moves, a vacuum cannot be formed and no serious trouble will be had.

I offer this analysis of the practical side of a steam boiler feed pump with the hope that it will not go over the heads of some of the readers, because the operation of a feed pump gets to be a very serious matter. As a boiler feed pump is a place where a reputation may be won or lost very easily, for that reason I prefer to inject the practical side. I respect Mr. Blum and his analysis, but for the sake of keeping fundamentals simple and easy to grasp for the beginner, I offer this cordially.

Perrysburg, O. WILLIAM H. GROVER.

PULVERIZER PETE'S PUZZLE PADDOCK PRIZE CONTEST No. 2

Two trolley cars, A and B, are on one track on two hills, x and y, like shown in the picture below.

Trolley car A is going down hill x with the throttle wide open, I mean the controller full on.

Trolley car B is headed up hill y with the controller full on, but it is rolling backwards. This is because the wire to the powerhouse is busted.

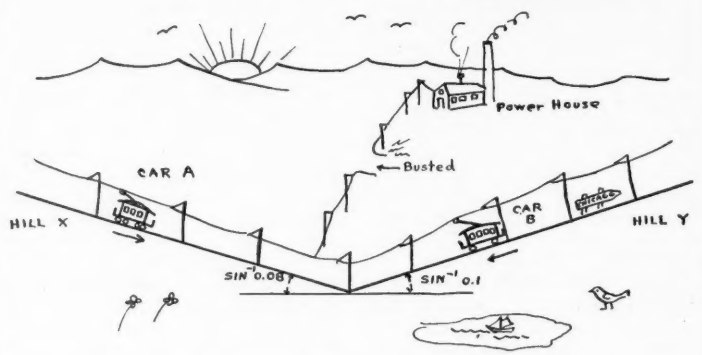
Now, the hills has got grades like in the picture, the trolleys have got one 50 hp. series motors which drives the trolleys 10 m.p.h. up a 10 percent grade. The cars weigh 10,000 lb. each.

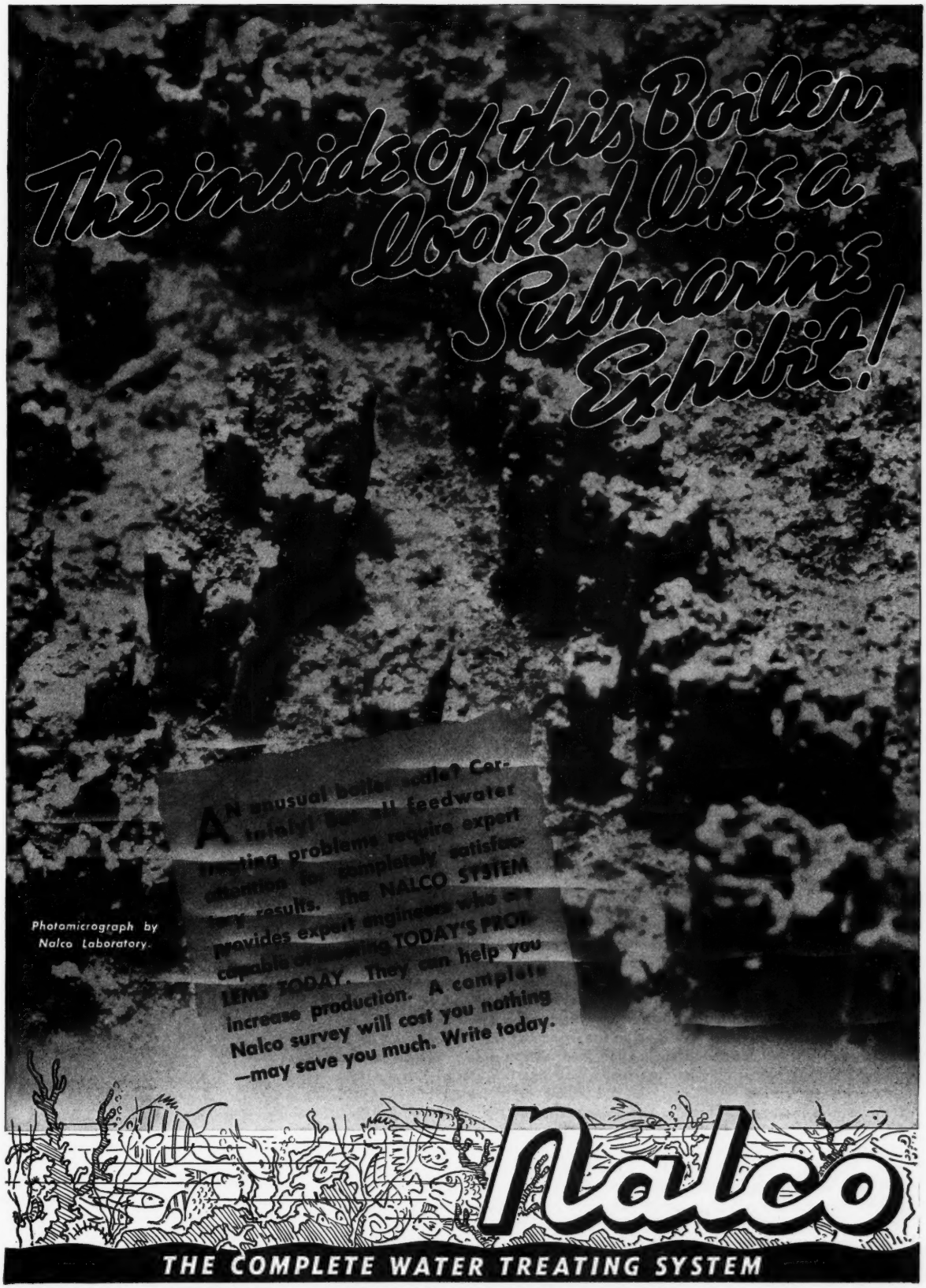
Trolley car A was going 20 m.p.h. when the wire busted and of course trolley car B which was going up hill y slowed down, stopped, and started to roll backwards like I says in the beginning.

What I wants to know is: how far does trolley car A have to roll to get going fast enough to pump enough juice into the line for to make trolley car B stop.

To everybody what sends me the right answer and a self-addressed stamped envelope and six cents in stamps I sends a souvenir from a foreign country if there is any left when I gets my answers. Please everybody insure the stamps in case the editor steals same.

PULVERIZER PETE.




The inside of this Boiler Looked like a Submarine Exhibit!
AN unusual boiler scale? Certainly! But it feedwater treating problems require expert attention for completely satisfactory results. The NALCO SYSTEM provides expert engineers who are capable of solving TODAY'S PROBLEMS TODAY. They can help you increase production. A complete Nalco survey will cost you nothing —may save you much. Write today.
Photomicrograph by Nalco Laboratory.
Nalco
THE COMPLETE WATER TREATING SYSTEM

NATIONAL ALUMINATE CORPORATION, 6224 West 66th Place, Chicago, Ill.

Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

HOW THE MISSING LINK WAS FOUND

Dear Mr. Kramer:

The "Fused Man's" missing link has been found and I want to thank you and POWER PLANT ENGINEERING for helping to locate it. In answer to the appeal in the Questions and Answers column[1] one of your readers sent me a set of four old-type open-link fuses. I doubt if I ever would have gotten one of these old link fuses had it not been for the published request in these pages.

William Hess, Chief Electrician, Metropolitan Life Insurance Co., sent this set of four fuses. Donald Osterhoudt of Poughkeepsie, N. Y., also supplied me with some and others were sent in by Charles Comitsch, Twin City Lines, St. Paul, Minn.

Many other fuses were sent to me, some real old timers. There is one fuse from Treasure Island, San Francisco, another used in lighting the Statue of Liberty, the N. Y. World's Fair Trylon, the City of Light, the Lagoon of Nations and the House of Magic. One came from Death Valley Scotty, one from the Bahamas—the Duke of Windsor. You have heard of 6 in 1 fuses; well, the Mayor of Yonkers sent me a fuse from the City Hall and a brass 8 in 1 fuse, a very rare fuse.

All the world loves a hobby or is it the novelty? Anyway, I have noticed it in New York; everybody is in a rush until they meet a fellow on the street who is selling a gadget, then they forget about where they are rushing and stop to look.

The fused man has left the corner of the basement tinkering shop where he stood for years. I hated to see him go; I had looked at him so long I actually miss him now.

First, he went to an exhibit at the Marble Collegiate Church, Fifth Ave. and West 29th St., New York City. From there he went to the National Hobby Club in the London Terrace Apartments on West 24th St., Robert Ripley is chairman of this club.

But this is not all. "Variety," the theatrical paper sent for data on the old fuses that came from theatres. Ripley or King Features is going to use a drawing of the fused man in their comic section newspaper feature; I don't know just when. Columbia University wants a loan of him to exhibit him in their museum. My boy's electrical teacher in the East New York Vocational High School wants to borrow him.

"Wide World" took pictures of him at the church. A radio announcer, I think he is connected with the Consolidated Edison "Echos of New York" program, checked and double-checked him at the Fifth Avenue Church.

What will happen while he is at the London Terrace Apartments is hard to tell—let's hope he doesn't go high hat on me and never come back to Brooklyn. Oh yes, I almost forgot this; at the church where he was out for the first time in 25 yr. he won a prize as the most novel exhibit.

Well, he has a balanced load now and should be able to navigate, thanks to POWER PLANT ENGINEERING and to Mr. Osterhoudt of Poughkeepsie, N. Y. Frankly, after learning that there were only two known open-link fuses of the old type[2] I did not expect to get any results from the appeal you published, but, sure enough, there were some.

The links sent in by Mr. Hess are very brittle from age so I have placed them in a small glass case.

The fuses Mr. Osterhoudt sent are about the first make of the cartridge type; one of the fuses marked "No ark" has a china case covering. On another one the lugs are marked on the ends and they were used with bolts.

Mr. Comitsch sent me two old airplane fuses. The fuses from California are of the modern type and fine for the collection because of their geographical interest. One fuse which arrived with no name or address of the sender, was a cartridge fuse with the case made of bamboo.

In closing I want to thank you again and I will let you know how the fused man makes out in his travels.

Brooklyn, N. Y. GEORGE E. HAWKINS.

[1]Page 77, January issue.

[2]At the Edison Works at Orange, N. J.

THOSE who did not read the original article in the November issue or the request for the missing link may be interested in the following brief description of Mr. Hawkins' interesting collection. The "Fused Man" as he calls it is a wooden man 7 ft. tall, a yard wide, and a foot deep. He was born in Mr. Hawkins' basement workshop in Brooklyn, where he stood for many years until a building inspector discovered him and directed him to the attention of a local museum. What makes the figure interesting is the fact that over 400 different types of electric fuses are plugged into his body. He has fused eyes, fused ears, a fused nose and mouth and fused hands and feet. ¶In this collection of fuses are fuses that were salvaged by the collector from well-known landmarks; fuses that were used in old ferry houses, schools, churches, docks, fairs, etc. For over 25 yr. Mr. Hawkins gathered old and antique fuses from wherever he could find them. In the collection are fuses sent in by interested people from all parts of the country. There are fuses from the San Francisco Exposition on Treasure Island. Plugged into the fused man's chest is a large fuse used in the Trylon at the New York World's Fair. There is an old fuse in the collection that was used at one time for the Statue of Liberty torch; another fuse came from the Capitol at Washington. ¶Some of the closed top type of fuses date back 50 yr. There are old plug type fuses made from all types of metal and glass. Two fuses in the collection have jewel glass tops, one red, the other green; these were models made for a Japanese inventor but never put on the market because the wire is not visible through the colored glass. The fused man now sports them as rings. The missing link fuses added to the collection as a result of the published request in these columns are old style open link fuses commonly used around 1890. One fuse in the collection was salvaged after a large circus had moved away, this fuse has a magnifying glass set in the top. Started in an obscure basement tinkering shop, the fused man built of plywood, tin, wire, BX cable, etc. today occupies swank exhibit rooms and gets more care and attention as Mr. Hawkins puts it, "than this old everyday electrician got in 50 yr."

Cold Water Breaks Hot Slag

IT HAS been demonstrated to this writer's satisfaction that where slag forms and bakes onto the lower row of tubes of water tube boilers, as it often does, cold water is an excellent agent for its removal. It is far better than steam, which is commonly used. The reason for breaking up of hot slag with cold water is the same as the reason for the breaking of hot dishes and glasses when suddenly cooled. The cold water causes the slag to crack and fall off in large pieces. In these demonstrations it was also proved that freeing the tubes of slag increases the chimney draft, helps maintain high efficiency, and saves much money due to the time previously required for laying up and cleaning boilers. Now the cleaning in this demonstration plant is done while the boilers are in operation. During the cleaning process the temperature of the flue gases was reduced approximately 15 deg. The cold water was introduced into the boiler and onto the hot slag by means of an old-fashioned hand lance.

Caution:—It is important to exercise care in introducing the cold water so that it will not touch the furnace walls. Cold water on hot wall will crack the wall as readily as it will crack the slag. Be sure to confine the water to the slag only.

W. F. SCHAPHORST

Newark, N. J.

We Invite Comparison

and then . . .

You be the Judge

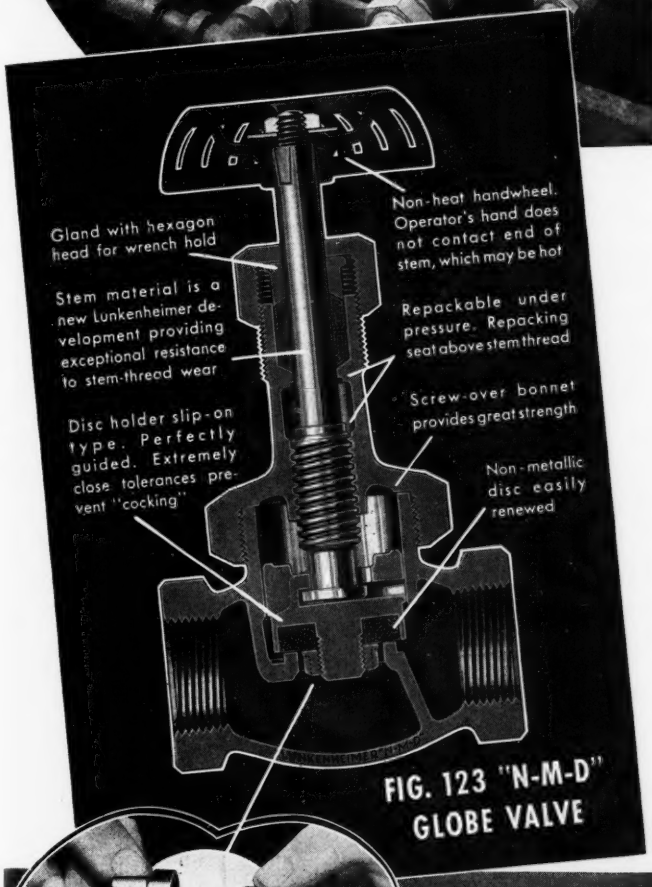
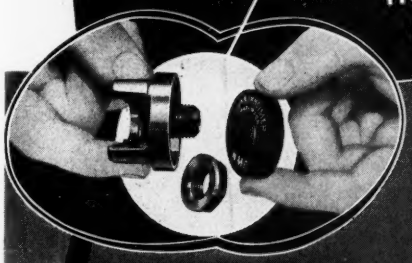

Gland with hexagon head for wrench hold
Stem material is a new Lunkenheimer development providing exceptional resistance to stem-thread wear
Disc holder slip-on type. Perfectly guided. Extremely close tolerances prevent "cocking"
Non-heat handwheel. Operator's hand does not contact end of stem, which may be hot
Repackable under pressure. Repacking seat above stem thread
Screw-over bonnet provides great strength
Non-metallic disc easily renewed

FIG. 123 "N-M-D" GLOBE VALVE

Direct comparison is a sound basis on which to buy. We believe that the "N-M-D" Valve is the finest valve in its class. We want you to believe it. The most convincing way we know to prove it is to suggest a direct comparison with any other make of valve designed for the same services.

Tell your Lunkenheimer distributor you want to see a Fig. 123 "N-M-D" VALVE. First, examine it externally — *critically*. Note the fine casting—get its feel of sturdiness. Then take it apart . . . compare it point by point — from every angle of service-giving design and construction. We'll rest the case in your hands.

"N-M-D" Valves are made in Globe, Angle, Check and Quick Operating Patterns — with various types of discs for steam, hot water, cold water, air, gas, gasoline, oil, butane and propane. Available from Lunkenheimer distributors in all industrial centers.



ESTABLISHED 1862

THE LUNKENHEIMER CO.

—"QUALITY"—

CINCINNATI, OHIO, U. S. A.

NEW YORK CHICAGO
BOSTON PHILADELPHIA

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

LUNKENHEIMER

· FOR BETTER SERVICE · STANDARDIZE ON LUNKENHEIMER ·

Send for copy of Catalog No. 78. We will include our handy "Guide", for easy selection of valves, boiler mountings and lubricating devices.

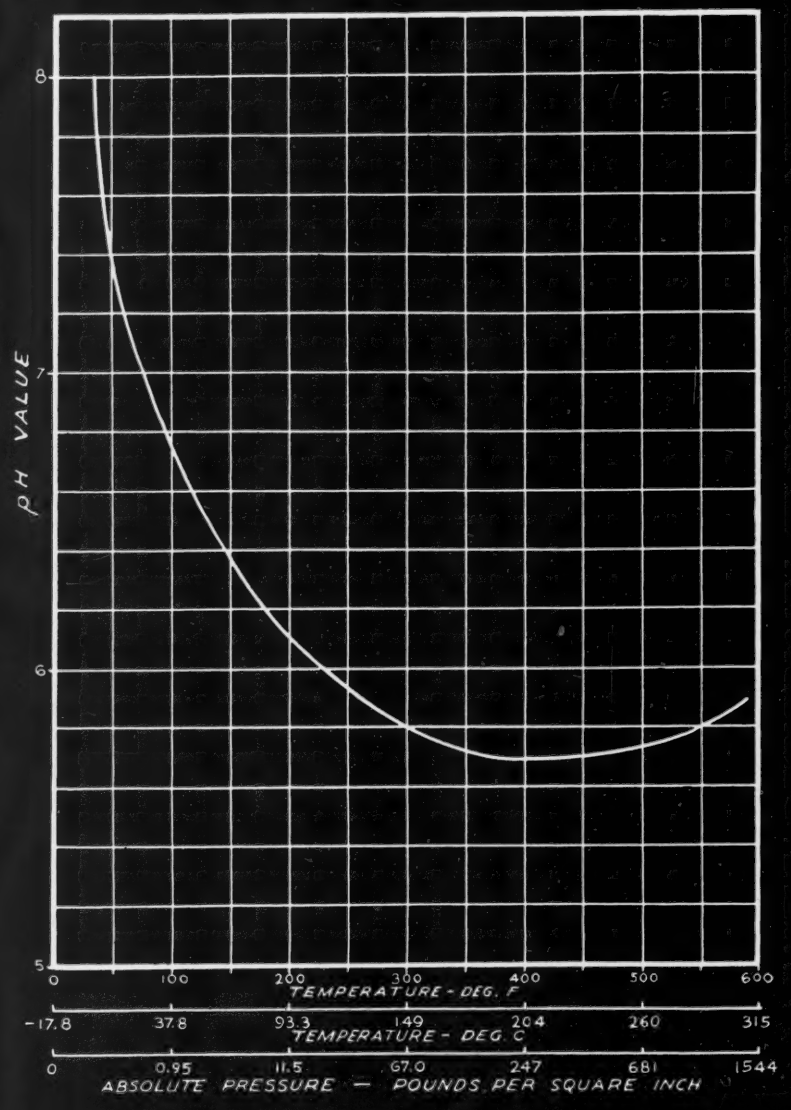


CHART SHOWING VARIATION OF pH WITH TEMPERATURE

COURTESY W. H. & L. D. BETZ

The pH Value, or the concentration of ionizable hydrogen per liter, at which neutrality exists with respect to H^+ ions and OH^- ions varies with temperature. As indicated by the chart above, in a pure water and in the absence of buffer salts, the point of neutrality can be as low as 5.7 at 450° F., a temperature commonly encountered in boiler operation. This phenomenon is of importance to provide proper protection against corrosive tendencies noted in presence of low pH Values, realizing that the true pH Value of boiler water at temperature of boiler operation will be lower than at measured pH Value of a boiler water sample at room temperature. The difference between true and measured pH Values will be less than shown by the chart in the presence of buffer salts found in boiler water.

WE BROKE WITH TRADITION TO BUILD THIS NEW MOTOR

TRI CLAD INDUCTION MOTOR GIVES EXTRA PROTECTION 3 WAYS

Integral-hp motors through 20 hp (at 3600 rpm) sizes, open or splashproof construction, are now available.

1 Extra Protection AGAINST PHYSICAL DAMAGE

One-piece cast-iron frame and cast-iron end shields protect the vital parts—from external blows, falling objects, or dripping liquids—keep them safe and secure even under slam-bang conditions.

2 Extra Protection AGAINST ELECTRICAL BREAKDOWN

Stator winding of Formex wire gives extra protection against moisture, oil abrasion, and heat-aging. New synthetic-resin bonding varnish and Glyptal No. 1201 red on end windings make a sturdy unit with a durable finish.

3 Extra Protection AGAINST OPERATING WEAR AND TEAR

Sleeve bearings are of new design, and have a method of grooving that assures a continuous oil film over the entire bearing surface. A new and simple ball-bearing mounting assures correct alignment and exclusion of foreign materials.

OUR field studies had shown that, more and more, the requirements of industry were demanding a vastly improved general-purpose motor, and it was apparent that this demanded a radically new approach on the part of the designer. Only by matching up *all* the new wants and *all* the new ways of doing things, in a supreme effort to make a *long jump* ahead—instead of the traditional *step* ahead—was it possible to achieve this truly modern motor.

And now you have the Tri-Clad motor—a completely new design. Because so many major improvements have been concentrated in one motor, we had to have just that much more assurance that each one was thoroughly practical. Never before, we believe, has the manufacturer required a motor to prove itself so thoroughly in advance of initial sale.

Whatever the task you have for a general-purpose motor—whatever your special concern for appearance, convenience, quietness, *or* protection—you will find that the performance-tested features of the Tri-Clad motor will give you specific benefits on the job. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

750-38

WHAT ABOUT BRONZE?

Although dating back to biblical times and still one of the most common of engineering materials, few are fully acquainted with the full possibilities and properties of this versatile material.

By JOHN E. HYLER

BRONZE[1] has a veritable host of friends who are not deeply concerned about the various aspects of its metallurgy but give it preference because they like the looks of it in some ornamental capacity, or because they have learned to appreciate its dependable utility. On the other hand, many have examined the material and its possibilities more closely and have learned the advantages of using different alloys for different purposes. The copper-tin alloys may vary considerably as to their tin content, but it is very seldom that bronze to be worked cold will exceed seven or eight per cent of tin, with the balance nearly all copper. Much of it will be below this in tin content. There have always been some differences of opinion as to the ideal mixture and doubtless this will always be the case.

A very remarkable increase in strength takes place when tin is alloyed with copper, and designers have found that the resulting bronze may be very effectively used in tubing and in pipe for various special duties. One of the most remarkable things along this line that we have seen is a bellows type of flexible metal tubing[2] that has been made from bronze tubing of high-tensile strength. This type of flexible tubing may be used for carrying either liquids or gases under high pressure. Others make flexible bronze tubing with the well-known type of interlocking joint quite often found in galvanized steel. Tubes of this kind run from a small diameter of ¼ in. or less up to 3 in.

Fittings and Valves

Bronze tubes find a niche in product design. As an interesting case in point, we have encountered a highly efficient steam trap which has its discharge tube made of bronze, as well as incorporating other bronze parts. The very decided resistance offered by bronze to most corrosive conditions has much to do with its choice in cases of this kind, though its superior strength also contributes toward the choosing.

Use of bronze extends to a large number of quality fittings and valves for application to pipe lines.[3] We have in mind a pipe line strainer unit, in which not only the strainer body, but also the inserted strainer screen unit, may be had in bronze. The spherically-designed seats of some high-quality pipe unions are of bronze and there are cases in which hydraulic valve bodies are furnished in drop-forged bronze. Use on hydraulic service speaks loudly for the dependability of the material, especially with reference to strength. Another item which may be had in bronze, and which is very well worthy of consideration, is the body of a pressure regulator of outstanding design.

Magnetic Properties

A fact well worthy of note with reference to bronze is the value of the material with regard to the preservation of magnetic strength when used as spacers in magnetic separators. One of the foremost builders of magnetic separators uses spacer rings of bronze in his separators in order to obtain a superior product. He makes the claim that if and when steel spacers are used, the magnetic lines of force are short circuited, thus weakening the magnetic pull. Some have not learned this interesting fact, and continue to use steel spacers.

Varied Analysis

The exact analysis of bronze is in most cases left to those who are prepared and qualified to furnish it in different alloys and in different forms. Some firms are prepared to furnish the material to almost any reasonable specifications. At least one manufacturer we know of supplies architectural bronze, phosphor bronze or Tobin bronze, in addition to all the ordinary types, and handles bronze in sheet form, or in rods, wire, rolls, channels, angles or tubes. Another specializes in hardware bronze with a lead content, manganese bronze and forging bronze. Some there are who furnish special acid resisting bronzes and still others are bearing bronze specialists.

Tobin bronze is a special alloy developed for use in contact with salt water, which is highly corrosive to most metals. It is much favored for boat propeller shafting, boat plates and like uses. Phosphor bronze or spring bronze, as it is sometimes termed, is used for turbine blades and is also a splendid spring material. Phosphor bronze is also a good material for the magnetic spacers referred to above.

(Continued on page 104)

[1]ED. NOTE. Inasmuch as this was intended as a general article on bronze and its uses and not an artice dealing with the product or application of any one company, trade names have been omitted by the author. The article, however, is of a practical nature, dealing with application, products and equipment of the market commercially so the author has compiled a list of 29 such companies. This list will be sent free of charge to readers who request it within a period of three months. The requests should be directed to the Engineering Editor.

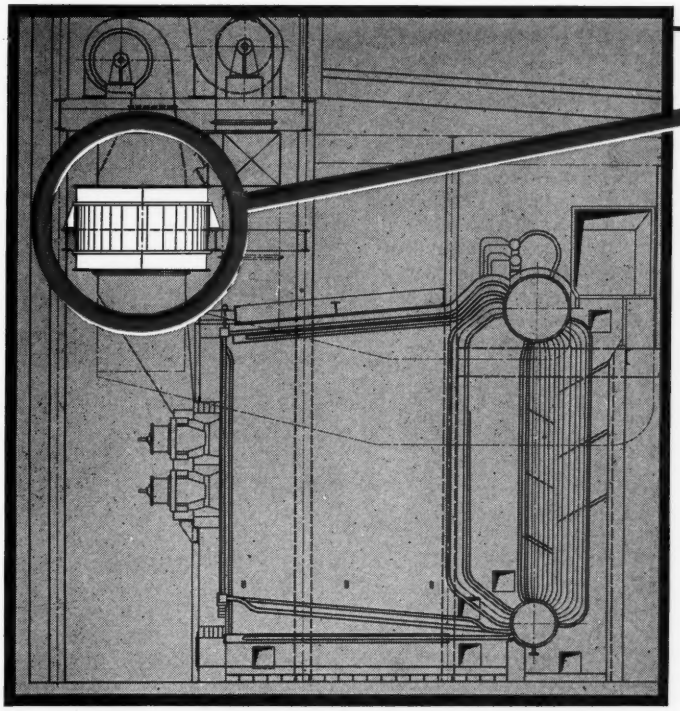
[2]ED. NOTE. Brass and Bronze are often used loosely and interchangeably. Brass is a generic name (supposedly derived from the Anglo-Saxon word brae meaning a fire produced metal) given to alloys of copper and zinc. The proportions range from 60 to 90 per cent copper and 40 to 10 per cent zinc; red brass runs 10 per cent zinc, cartridge brass 30 per cent zinc; ordinary or yellow brass 33 per cent zinc; and muntz metal, patented in 1832 for ship sheathing and now widely used for condenser tubes, 40 per cent zinc. Sometimes one per cent of the zinc is replaced by lead to improve its workability.

Bronze is an alloy of copper and tin or copper, zinc and tin, the approximate limiting proportions being copper 70 to 90 per cent; zinc 10 to 30 per cent; tin 1 to 18 per cent. Admiralty metal, (originally A. gunmetal) is: copper 88 per cent; tin 10 per cent; zinc 2 per cent. It has a high tensile strength, is corrosion resistant, and was developed by or for the British Navy. It is now probably the most widely used condenser tube alloy. Tobin bronze or Delta metal was developed about 1883 and a typical analysis is: copper 55 per cent; zinc 43.5 per cent; iron 1 per cent; lead 0.4 per cent; phosphorus 0.1 per cent.

[3]ED. NOTE. In general bronze or brass fittings and valves are limited to a maximum temperature of 500 deg. F. and brass and copper pipe to 406 deg. F. for steam, gas and air piping systems by the Code for Pressure Piping. For oil the limits are further reduced to 350 or 400 deg. F. and prohibited where a fire hazard is involved. When these limits are approached careful study should be made of the code which can be obtained for $1 a copy from the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

It Goes Double for Scott

At Scott Paper Company, Chester, Pa., one Ljungstrom Air Preheater has served since 1935; another went in on new boiler in 1938



In the manufacture of paper products, efficient steam generation is a vital factor. The Scott Paper Company has made it a point to keep "ahead of the game" with modern, high efficiency power plant units. In a steam generating unit of 125,000 lb. per hr. capacity purchased in 1935, a Ljungstrom was selected to preheat incoming air to 460 deg. F.

In 1938, on another 125,000 lb. per hr. unit built by another boiler manufacturer, the call again went to Ljungstrom. In this unit (left) gases enter the preheater at 745 deg., leave at 373 deg., heating combustion air to 489 deg. F. To date, service records on both units have justified the consistent choice.

The Modern Ljungstrom Air Preheater

To the recognized thermal superiority of the *continuous regenerative counterflow* principle, the *modern* Ljungstrom Air Preheater now adds an extra measure of mechanical surety. The resulting clear margin of advantage for the Ljungstrom in any economic balance calling for high levels of heat recovery is indicated by today's installation records: Today more Ljungstroms are being installed in power plants than all other types of air preheaters combined.

Engineering evidence which confirms this margin of advantage — evidence which shows how constructional improvements have stepped up present-day performance—is available on request. It will be of noteworthy economic interest to engineers and other executives concerned with power-plant design or responsible for operating efficiency and availability. May we send a copy?

THE AIR PREHEATER CORPORATION

60 East 42nd Street **New York, N. Y.**

(Continued from page 102)

Addition of zinc or phosphorus make bronze easier to cast, though bronzes with a zinc content are not in general so resistant to corrosion as those which have none. On the other hand, the addition of lead to bronze has the effect of greatly increasing its machinability; even the addition of less than one per cent of lead will make a great difference in this respect.

Variation takes place in the color or bronze as its tin content varies. Where the tin content is very low, the coppery color prevails, but this grows lighter and tends more toward a deep yellow as the tin content is increased. It follows that to a considerable extent, the color of architectural and other ornamental bronzes may be controlled by the analysis.

Bronze for Bearings

Probably not a mechanic could be found who is altogether unacquainted with the use of bronze, particularly bronze bushings, in bearings. Not all bearings, however, are of ordinary bushing type where bronze is used. An interesting instance of an exception is found in a variable-speed pulley mechanism, in which the design contemplates two Bakelite disks with tapered faces, riding on a bronze sleeve. Three objectives are gained by the use of this bronze sleeve. First, the wearing qualities of the devise are improved, second, there is resistance to corrosion, and third, static electricity is insulated.

Electric motor bearings are often made of bronze and one specialist alone makes as many as 200 different kinds and claims to have more than 700 different sizes of general-purpose bronze bearings. The importance of bronze in this particular part of the industrial field may be very readily seen. Another outstanding manufacturer of bearing bronze offers it in bars, either in solid or in cored form, and to practically any size or diameter desired.

A very interesting proposition with reference to bronze bearings is the case of such being made from powdered bronze, molded into bushing form under pressure, and incorporating a lubricant right in with the powdered bronze. It is said that the bearings are impregnated with sufficient lubricant to last for the life of the equipment in which they are used, in a good many cases.

Working Aspects

Problems inherent in the cleaning of bronze parts are much the same as those for brass and manufacturers of cleaning agents are always glad to recommend the proper procedure for cleaning a bronze of any particular analysis. Bronze wire may be drawn to good advantage, using a proper drawing soap for the purpose, but since bronze wire is available in the markets, only large users will have any particular interest in drawing it. Bronze bars, shapes and sheets of all kinds may be machined on a bandsaw, so far as cutting them to shape is concerned. Very thin sheets of material, however, will be better cut by the use of a nibbling machine, a rotary shear, or, in the case of job work that varies to a considerable extent, with one of the portable sheet metal shears on the market.

Many know that bronze rod is much used for welding. It is interesting, in this connection, to note that bronze rods have been developed that are fumeless. They can be used for the bronze welding of cast iron, of malleable iron or of steel, in addition to the fusion welding of brass, bronze and other copper alloys. Neither is the application of bronze with reference to its local deposition limited to the use of welding rod, for bronze may be applied to worn shafting, etc., to build up worn bearing seats, journals and the like, by spraying the material on with a metal spraying gun. This process is considerably faster for that type of work than the application of metal by welding.

Tools

Filing of bronze is something of a special problem if it is to be done efficiently and it is worth while knowing that some firms make up special files for this purpose. A tool adapted to the peculiar characteristics of a given material is always the best one to use if and when it is available. On the other hand, bronze itself makes good tools for special purposes. For instance in a hazardous or explosive location tools of non-sparking bronze are very often indicated. Another interesting fact about bronze for tools is that in some instances it is very easy on the surfaces of work being handled. Automatic screw machine fingers, as furnished by one of the foremost supply houses, are provided with bronze pads to contact the work when protection of the work surfaces is the important factor.

Heat Resistant

One of the interesting things about bronze is its capacity for resistance to a high degree of heat. Copper is a quick conductor of heat and it follows that bronze will also conduct it quickly, in addition to having the necessary stamina for rigorous duty. A certain melting kettle for tar, asphalt and similar materials for instance has a bronze regulating valve for the burner and a gasoline torch has a bronze burner of two-piece construction. Therefore, whether it is heat or corrosion that must be dealt with, bronze is a logical candidate for important parts.

There are of course many special corrosion problems arising from time to time that are ultimately solved by the use of the proper type of bronze. A small centrifugal pump for cellar drainage or sump service has the shaft and impeller of bronze, in order that corrosion may adequately be resisted. At the other extreme is a heavy duty, two-stage centrifugal that will pump against heads as great as 500 ft. This pump, also, has both its impellers of bronze.

Acid-resisting bronzes were mentioned as being furnished by some manufacturers. An instance of their application is seen where an acid-resisting connection was needed and used for an acid-proof kettle, the body of which is made of a plastic-asbestos material. Again, the propeller on a mixing machine noted, which must not be subject to easy corrosion, is made of nickel-clad bronze.

Bronze has many uses which have not been mentioned here, but the ones cited may be considered as outstanding, and may be regarded as suggestive of others. One may find bronze most anywhere. A certain type of flexible coupling has bushings that are lined with it. While the behavior of the material in its varied analysis is quite well known by authorities, there still remains room for further development and research, especially as new problems arise in the mechanical world. One thing seems certain. Bronze will fill a place of increasing importance in the future.

INDUSTRY'S CHOICE!
FOR DRIP AND DRAIN LINES
CRANE No. 212-P PLUG TYPE GLOBE VALVES
(up to 250 pounds, Steam)
For dependable flow control in every service look to the great Crane line of 38,000 valves and fittings. There's a well-stocked Crane Branch or Wholesaler serving every industrial district.
Extra wide seating surface resists wire drawing and erosive effects of foreign matter. Tapered disc of Nickel Alloy permits fine, accurate flow regulation. Seat ring is renewable; of Exelloy, specially hardened to withstand hard wear and temperatures. Body is heavy brass; easily dismantled and re-assembled.
CRANE
250

CRANE

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

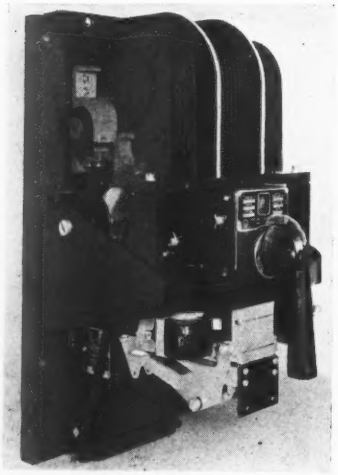
CRANE CO., GENERAL OFFICES: 836 SOUTH MICHIGAN AVENUE, CHICAGO

New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Circuit Breaker

I-T-E CIRCUIT BREAKER Co., Philadelphia, Pa., announces a Type KA circuit breaker which is an addition to their Type K line. It is similar in many respects to the Type KB, being rugged, compact, and quick-acting, and it is

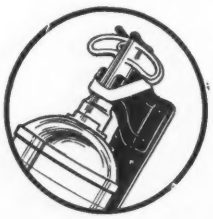


available either electrically or manually operated, in ratings up to 225 amp., 250 v. d.c., or 600 v. a.c. with interrupting capacity of 15,000 RMS amp.

Various types of mountings may be obtained including the standard enclosed individually mounted dust proof enclosure, open panel mounting, and in dead front switchboards.

Extinguisher Safeguard

FIRE extinguishers should be kept ready for emergency use, and, after use, should not be returned empty to their brackets. To facilitate frequent inspection and to tell whether pump-type extinguishers have been tampered with or used, Gardeseals, recently introduced by

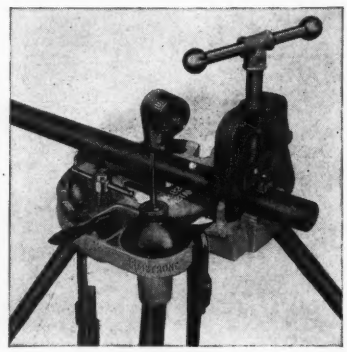


the Pyrene Mfg. Co., Newark, N. J., which are bright red bands and are placed over the extinguisher handles and bracket and are destroyed the moment an extinguisher is taken from its bracket. These bands are easily applied by soaking in water and placing over the handle and bracket, which shrinks to a tight seal in an hour.

Heavy Duty Integral Vistand

THE NEW heavy-duty No. 933 Vistand announced by Armstrong Mfg. Co., Bridgeport, Conn., is designed for either portable or stationary use. The portable unit has spreads of 50 in. in front and 43 in. from front to rear leg, which insures against tilting and tipping.

The features of the platform, which measures 14 in. in both width and depth, include tool notches and slots around the rim, oil-can recess, and a special dope pot. Equipment also includes three benders; one for ¾ in. pipe and reverse benders for ½ and ¾ in. pipe, placed directly over the right front leg to prevent tipping during the bending operation.



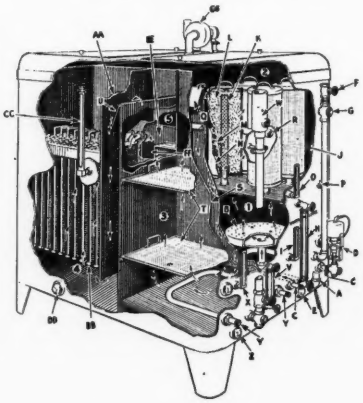
The unit has a ceiling brace and its feet are punched for attaching to the floor, or it may be used with Armstrong-Bridgeport's new skidless rubber shoes that prevent skidding or scratches on the most highly polished floor. The improved vise has a new double-quick screw with frictionless disk to protect the fast-moving tip. The one-piece slide rides on the outside of the frame. The vise jaws are heat-treated by a patented process and have hard, long-wearing teeth accurately spaced to hold each size of pipe. Each tooth is undercut to prevent it from filling up with scale.

Oil Conditioners

AFTER a long period of laboratory and field development, S. F. Bowser and Co., Inc., Fort Wayne, Ind., announces the new Fig. 832 Oil Conditioner in four sizes ranging from 45 to about 1080 g.p.h. The units are intended for acid correction and to prevent build-up of acids in turbine oils.

The unit is built in four compartments: acid correction; precipitation; filtration; and clean oil storage. About 25 percent of the oil flow is directed through the acid correction compartment and the balance goes direct to the precipitation compartment. Operation is as follows:

Oil entering correction compartment 1 flows through the control orifice A, up through diffusing orifices in spreader plate B and thence through a heated water bath maintained at a controlled level and temperature . . . then into dehydrating compartment 2 via perforated core K, mass L, cloth bag M and screen



N in dehydration elements J. It then flows over weir Q and joins the rest of the oil entering precipitation compartment 3 through inlet R, flowing downward and under baffle S where entrained water, contained in that portion of the oil not conditioned, is precipitated and automatically removed through water ejector W, upward through screens T, over weir U, thence downward and under baffle AA into the filtering compartment 4. After flowing through the cloth covered filtering elements BB the filtered oil passes through the outlet nozzles into troughs EE and conductor pipe FF in the clean oil compartment, from which it is pumped back into the oil reservoir. Vent fan GG mounted on top of the cover to remove formation of moisture inside the conditioner is operated only as required.

V-Belt Driver Sheave

NEW V-BELT driver sheave, designated as the Q-D quick detachable and quick demountable type, is announced by Worthington Pump and Machinery Corp., Harrison, N. J. Simply constructed and suitable for application where quick mounting of sheave to shaft, and dismounting from shaft, are desirable, as on equipment where speed ratios must be changed to meet varying conditions, such as fans, blowers, printing presses and machine tools. It eliminates

How to Save $15,000

A REMARKABLE CASE SHOWING SCOVILL'S "3-WAY" CONDENSER TUBE SERVICE IN ACTION

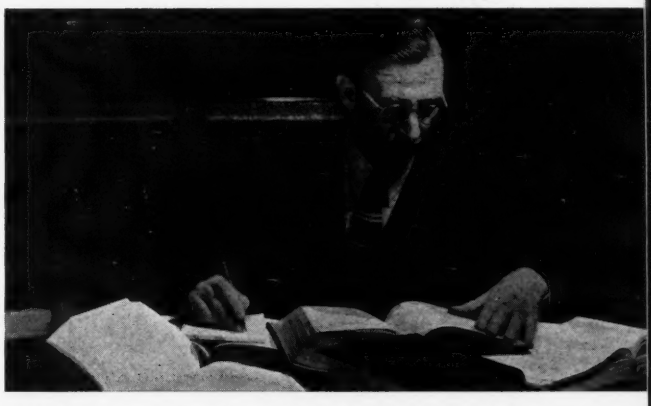
For buyers of Scovill Heat Exchanger Tubes, the actual purchase of the tube is only a part of the story. In close touch with the problems of tube users, Scovill offers them its 3-way service—in men, metals and manuals—designed to reduce the costs and save the time of the engineer. Pictures on this page show Scovill's 3 services in action.

MEN A power plant engineer, because of enlarged tube sheet holes, was experiencing chronic leaks at the ferrule and packing joints of his condenser. He pondered replacement of the $15,000 tube sheets but before doing so called a Scovill technical service man. Scovill suggested as an alternative a change in installation method which would eliminate the difficulties due to the enlarged tube sheet holes and eliminate the ferrule and packing as well. This change was made — saving $15,000.

SCOVILL CONDENSER TUBES one product . . . three services

- **SERVICE IN MEN**
- **SERVICE IN METALS**
- **SERVICE IN MANUALS**

METALS Admiralty alloy has for years been widely used for condenser, heat exchanger and heater service. It usually served well and economically, but in certain conditions failed from dezincification. Scovill engineers worked intimately with this problem — developed "Phosphorized Admiralty," * a new alloy which has all the good qualities of Admiralty but which will not fail from dezincification. And thousands of dollars thereby will be saved by operating companies in Power, Refinery and Marine Plants.



MANUALS And reflected in Scovill's new "Condenser Tubes" booklet is this constant development.

This "Condenser Tubes" booklet has money-saving facts for you, and will be sent on request. Address Scovill Manufacturing Co., 17 Mill Street, Waterbury, Connecticut.

*"Phosphorized Admiralty" tubes are covered by Patent Number 2,224,095.

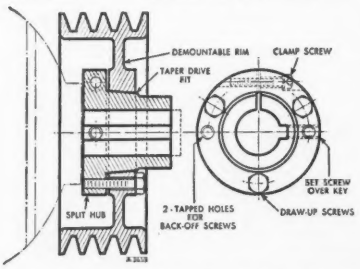
Scovill

MANUFACTURING COMPANY

WATERBURY, CONN.

the necessity of a wheel puller to remove wheel or hub from shaft in order to get at the driving unit.

Each sheave unit consists of two parts, a longitudinally-split or clamp hub and a V-grooved rim. The hub is clamped to the shaft by means of a cap screw in its flange and is securely fastened by a standard keyway. A fit equal to a press fit, on shafts up to ten thousandths over-size or under-size, is provided. The



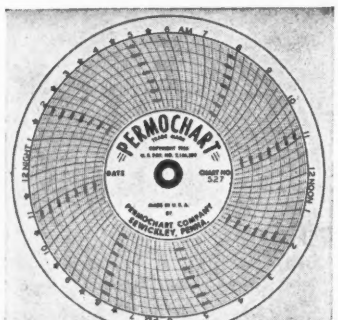
rim is taper-fitted to the hub and fastened with three draw bolts. To remove the rim, the draw bolts are withdrawn and two of them are inserted in holes so tapped in the rim that the bolts act as jamb screws and bear against the hub, thus forcing the rim off the taper without disturbing the position of the hub.

Type Q-D sheaves are available in the complete range of standard driver sizes.

Recording Instrument Chart

AN IMPROVED design in recording instrument charts made for continuous re-use has been developed by the Permochart Co., Sewickley, Pa.

Made of Vinylite plastic, Permocharts can be constantly re-used, as the previous day's ink record is easily removed from its surface with a damp cloth. Designed especially for industries such as petroleum refineries, pipeline companies, nat-



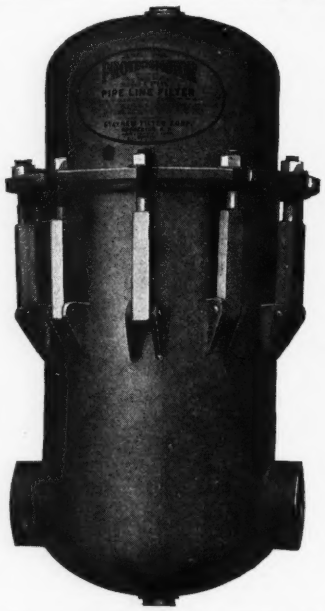
ural gasoline and gas producers, food, chemical companies, utilities including water, electric, gas, steam and sewage disposals, hospitals, breweries and distilleries, steel, smelting and metal refining, process and other similar industries where large numbers of recording instrument charts are used.

Permocharts of the latest type will not curl, are non-flammable, and are oil, gasoline and grease resistant. Because each chart is in use over a long period of time, chart centers are now reinforced to prevent deterioration, even from holding devices using sharp projections. Permocharts are made for all types of recording instruments which use circular charts, and also special charts can be made.

For applications where it is necessary to save chart records, the Permochart Co. has established a microfilm photographic system for recording and filing. This method greatly reduces filing space.

New Water Filter

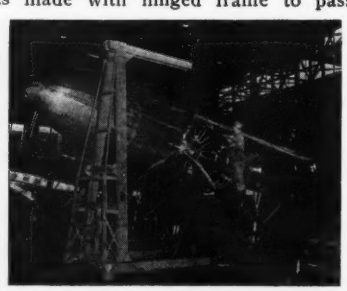
RADIAL Fin Construction for filters in air transmission lines has been adapted in a new model to the filtration of water by Staynew Filter Corp., Rochester, N. Y. Construction is simple, all water passing through special fabric filter mediums with minimum restriction to water flow. There are no moving parts



and the large filtering area, 11 in. high by 8¼ in. dia. gives a filtering area of 1325 sq. in., permits long periods of operation without attention. Insert can be removed by unbolting the head and removing one wing nut. Units can be arranged so that cleaning is effected by backwashing with clean water.

Utility Crane

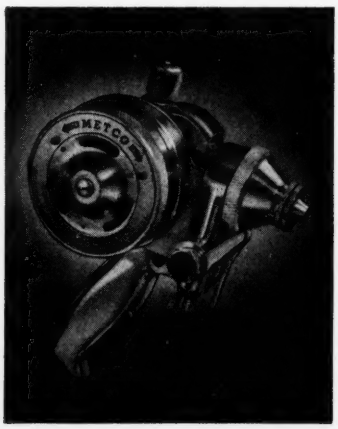
LEWIS-SHEPARD SALES CORP., Watertown, Mass., announce a portable crane for assembly or overhauling operations, such as handling heavy piping, valves, generator and turbine parts. This crane is made with hinged frame to pass



through doorways, telescopic frame for working at various heights, and also has a revolving base. Interchangeable winches permit use of hand or power operation. Capacity, lift and boom length are made to fit requirements.

Metallizing Gun

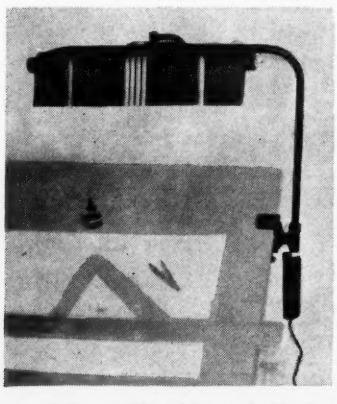
IN THE Metco Metallizing Gun, manufactured by Metallizing Engineering Co., Inc., Long Island City, N. Y., metal wire is fed in at adjustable speed, melted by concentrated flame, atomized by compressed air and sprayed on any base material. Use may be for coating structures or parts, or for building up worn shafts, plungers, cavitated turbine runners and the like, with steel, monel metal or



bronze. In the Type 2E gun, the controlled power unit, by means of a governor, gives steady wire feed, eliminating gear changes, and allows use of acetylene, propane, hydrogen, natural or manufactured gas in the universal gas head. Fine coatings are possible, with low gas consumption, and air pressure required is 65 p.s.i. Two-piece aluminum alloy case gives light weight and convenient upkeep. Parts are alined with dowel pins. Heat-proof-lined bronze wire nozzles avoid sticking of sprayed metal.

Desk or Bench Light

FOR LOCAL lighting of desk, drafting board or bench, Frederick Post Co., Chicago, Ill., is offering the Fluorescent Engineer's Lite, with clamp or



screwed base, adjustable vertically from table to 24 in. above and with shade adjustment of 360 deg. horizontally and 180 deg. vertically. A special pigment on the reflector produces a neutral colorless light, the lamp giving 2½ times that of an incandescent of equal wattage. Shade is finished in brown with silver trim.

MACHINING–TESTING–READY FOR USE!

In small valve manufacture, POWELL makes these last two operations your unqualified assurance of a finely wrought finished product!

From the drafting table to the pattern shop . . . then to the foundry, with constant laboratory control . . . next to the machine shop, where the rough casting is finished, assembled, and finally tested. This, in short, describes the evolution of a Powell small valve.

Only the most modern machines and efficient tools are used . . . closest tolerances are maintained, and constant inspection of parts as they go through is the rule. Each part of a certain type of small valve must be interchangeable with any other similar part. Each part must meet the rigid quality requirements laid down by Powell. Then after assembly, on to the testing department, where valve after valve is tested under pressures far exceeding its rated capacity. If, for any reason, there's a flaw in a Powell small valve, it's discovered here. Then, only after this searching examination . . . the valve is declared satisfactory, and is approved for shipment.

So, after exhaustive preliminary design and materials tests, and painstaking manufacture, Powell small valves are ready to work for you . . . to go into efficient service on your small lines, and prove to you that, without a doubt, they're *"quality, through and through."*

POWELL VALVES

THE WM. POWELL COMPANY • CINCINNATI, OHIO

You Need More Than a Photograph of the Finished Product to See ALL of the Qualities that Make Powell Valves Uniquely Able to Better Serve the Power Engineer

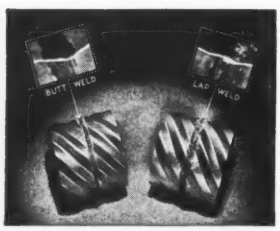
Cylinder Truck

A NEW HAND truck designed to carry an oxygen cylinder, an acetylene cylinder, and a complete welding and cutting outfit, has recently been announced by The Linde Air Products Co., a Unit of Union Carbide and Carbon Corp., New York, N. Y. This new truck—known as the Oxweld T-7 Two-Wheel

Welding Truck is light in weight, well balanced, and has 14 in. wheels equipped with semi-pneumatic rubber tires. The new design results in a 4½ in. reduction in overall width of the truck, permitting passage through narrower openings. As an added feature, the size of the removable metal tool box, for extra blowpipes, tips, goggles, and wrenches, has been increased.

Conduit With Welded Connections

THE RIC-WIL CO., Cleveland, Ohio, has developed an improved method of connecting the units in its underground conduit steam systems.



At the left of the illustration is a sample of butt-welding and at the right is shown a lap weld. The helical corrugations will match perfectly when rotated into position. For the lap joint ⅛ to ¼ in. lap of metal is obtained by springing the edge on one of the conduits. After welding the joint is protected against deterioration by ¼ in. thick asphalt blanket applied with a plumbers' torch to make bond with the metal. The asphalt is wrapped tightly with asbestos felt jacket to protect the asphalt coating. A joint with thin flanges welded to the conduit and welded at the outer edge can also be supplied.

Quick Response Voltage Regulator

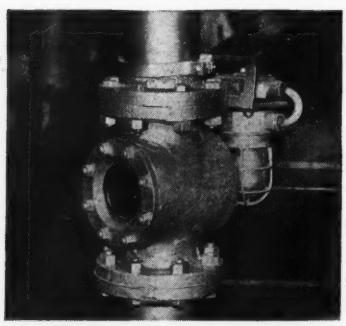
A NEW indirect-acting rheostatic generator-voltage regulator, designed especially for the automatic voltage control of medium and large size a.c. generators in central stations, or large municipal and industrial generating plants, and for synchronous motors and condensers, is announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This new type BJ regulator is especially adapted for use on systems where quick-response excitation is used to improve stability under fault, or large load conditions.

Greatest distinctive operational feature is its high-speed action time of 3 cycles after a voltage change. This and its ability to quickly force the exciter field to its limit makes it suitable for quick-response systems. The regulator element responds to average 3 phase voltage, hence will not operate falsely on an unbalanced system fault.

Indirect acting, the new regulator controls voltage by controlling a motor operated rheostat which varies the exciter field resistance. Rated sensitivity is plus or minus one-half of one per cent of normal voltage. The regulator comes in two mounting styles for switchboard use, projection or flush type cases.

Sight Glasses for Pipe Lines

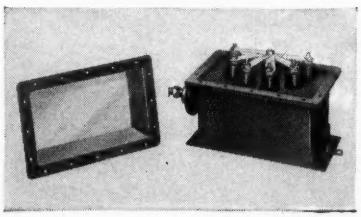
THE SIX Sight Glass fittings announced by Cochrane Corp., Philadelphia, Pa., last year have been supplemented by five smaller sizes with screwed connections. Sizes range from ¾ in. to 2 in. for the



new screwed connection fittings and from 2½ in. to 8 in. for the flanged design. Bodies are of cast iron for pressures to 125 lb. per sq. in. Pyrex windows are held in place by gasketed steel frames. Weights have been reduced on all sizes.

Carrier Current Capacitors

CORNELL-DUBILIER Electric Corp., South Plainfield, N. J., has recently added three new capacitors to its list—C-1003, a carrier current coupling capacitor, and C-1001 and C-1002 capacitors for carrier current traps.

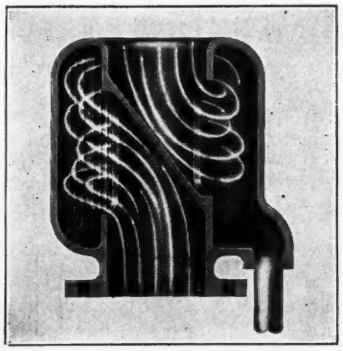


The new type C-1003, a low voltage coupling capacitor, is available in two sizes, and in all capacities up to .075 mfd. and voltages up to 15,000 v. These units, thoroughly impregnated and filled with Dykanol "C", are designed with low stress to give long, dependable service. An internal construction of low inductance makes them suitable for carrying the high frequency of the carrier.

Cornell-Dubilier has designed its two new capacitors for carrier current traps to meet severe working conditions. One is of the fixed capacity type whereas the one illustrated is adjustable over a wide range of values. They are oil filled mica dielectric capacitors, hermetically sealed in arc-welded steel cases protected by a durable coat of weather-resisting paint. High voltage wet process porcelain bushings are provided for terminals.

Exhaust Head

THE Cochrane Corp., Philadelphia, Pa., announces a new exhaust head which insures the separation of condensate and oil from steam discharged to atmosphere and thereby prevents raining of water and oily condensate upon the roof or ground below, at the same time discharging clean, dry steam noiselessly.



The new exhaust head incorporates the principles of the Cochrane baffle-type steam separators used for removing oil and moisture from steam lines. Exceptional port area produces low steam velocity and minimizes pressure loss. Steam is whipped sidewise and causes projection of entrainment against ribbed baffle surfaces. The high ribbed baffles exert a scrubbing action in addition to the centrifugal purging force. The exhaust head is of one piece semi-steel construction for 4 to 12 in. sizes and of welded plate for larger sizes.

ANOTHER OF THE REASONS WHY PERMUTIT* IS "WATER CONDITIONING HEADQUARTERS"

REVOLUTIONARY ZEO-KARB*

New feedwater treatment wins quick acceptance

Since its introduction by Permutit, after years of research, ZEO-KARB has proved its superiority in actual operation again and again.

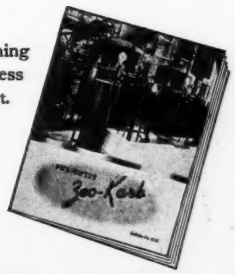
ZEO-KARB is a zeolite material, but possesses amazing new properties. It reduces hardness to zero, reduces total dissolved solids — and simultaneously reduces alkalinity to any desired value.

Unlike previous zeolites, ZEO-KARB is non-siliceous and acid-resistant, allowing regeneration by either acid or salt.

When regenerated with salt (ZEO-KARB Na), it operates in the sodium cycle, the same as previous zeolites.

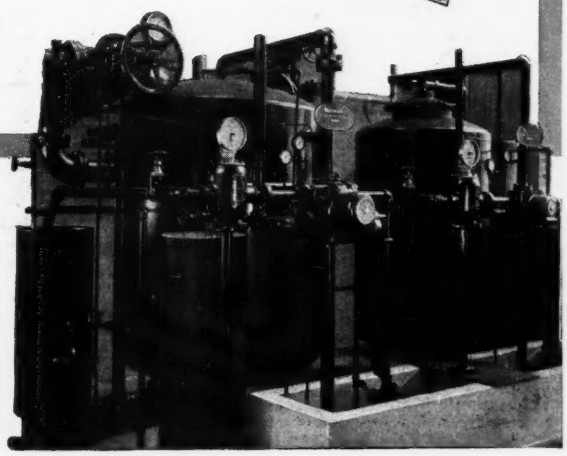
Regenerated with acid (ZEO-KARB H), it operates in the hydrogen cycle, converting all bicarbonate hardness to carbon dioxide and water — *by ion-exchange alone.* This free CO_2 is easily removed by aeration.

Write for free booklet containing complete technical data. Address The Permutit Company, Dept. A1, 330 West 42nd Street, New York, N. Y.



Power plants have been quick to recognize the advantages of ZEO-KARB. *Installations (like the one shown here) are in operation in many large plants.*

*Trademark Reg. U. S. Pat. Off.



PERMUTIT

WATER CONDITIONING HEADQUARTERS

Temperature Indicator

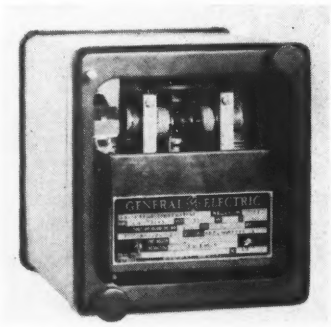
LEEDS and Northrup Co., Philadelphia, Pa., recently announced a new temperature indicator for those who need a portable instrument for thermocouple temperature measurements, for checking thermocouples, or for measuring small emf's, with additional precision.

Increased accuracy has been provided in this 8667 Indicator by calibrating only a small portion of the range on a continuously adjustable slidewire. The remainder, adjustable in fixed steps, is on a dial switch of ten highly accurate resistors. Range is from 0 to 111 millivolts with a limit of error of ±0.1 millivolt.

Built into this potentiometer are coarse and fine battery rheostats, pointer galvanometer, standard cell, battery, galvanometer key and standardizing key. The oak case is 12¼x7¾x7⅞ in. with hinged lid and carrying handle.

Temperature Relay

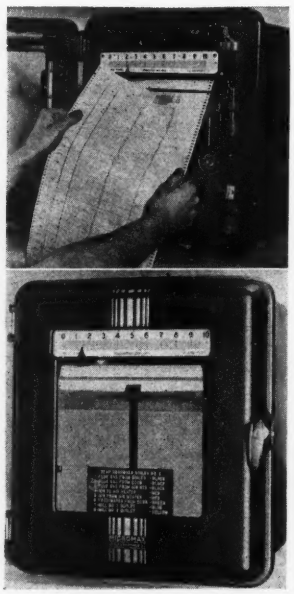
DESIGNATED as Type CFT, an improved relay is announced by General Electric Co., Schenectady, N. Y., for protecting machines and transformers against overloading. This serves as a galvanometer in a wheatstone bridge



which has a resistance temperature detector in one arm and tapped bridge resistors in the other three arms. It is adjusted to close its low-temperature contact at 80 deg. C. and its high-temperature contact at 95 deg. C., with air temperature of 30 deg. C. The balance point is midway between, at 87½ deg. C., but tapped resistors permit adjustment of the balance point to a higher or lower temperature, closing points remaining the same.

Tear-Off Device for Micromax Recorders

A NEW device, manufactured by Leeds and Northrup Co., Philadelphia, Pa., enables users of Micromax strip-chart recorders to tear off and file a record of each day's operation. Made to fit modern Micromax Recorders, which have been standard since 1936, the device can be quickly and easily attached. When used,

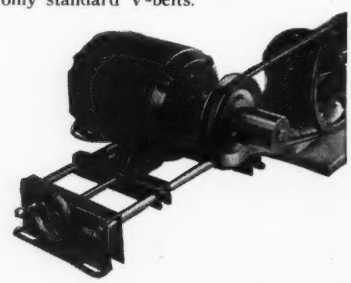


there is no wasted chart, and it is not necessary to rethread the chart through the guides. A rubber stamp can be furnished which identifies the recorder and the location of the thermocouples.

Daily strip-chart records are thus provided in a form as convenient to file as those from round-chart recorders, yet with the strip-chart advantage of a more detailed record, as well as the multiple-point feature available only with strip-charts.

Variable Speed Motor Pulley

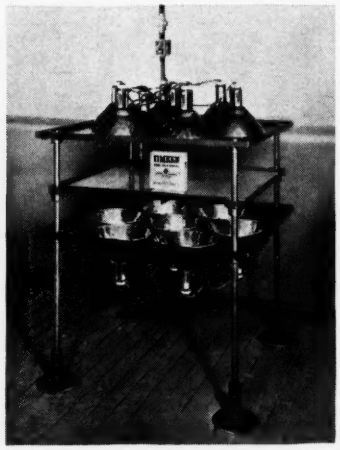
IDEAL Commutator Dresser Co., Sycamore, Ill., announces a new variable speed pulley, designed for light, inexpensive machinery, which mounts directly on the motor shaft and requires only standard V-belts.



Features include short overhang, forced lubrication and balanced sheave. Both halves of the sheave move, giving accurate belt alinement at all times. Pulley faces are curved to give full belt contact at all pitch diameters. Speed ratios up to 2¾ to 1 available. Sizes up to ¾ hp. Complete unit includes variable pitch pulley and adjustable sliding motor base. By turning the handwheel of the base, the motor moves backward or forward, causing an increase or decrease in belt tension, which causes the pulley to open or close, thus changing the pitch diameter and the driven speed. Speed changes are made while the drive is running.

Bearing Heater

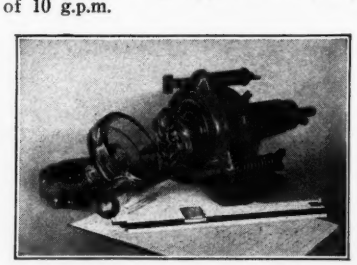
FOR HEATING bearing cones preparatory to assembling them on shafts where a tight press fit is required, Timken Roller Bearing Co., Canton, Ohio, has developed equipment consisting of three trays 4 ft. square and 12 in. apart. The



middle tray, on which cone bearings are placed without removing from boxes, is of Pyrex glass, top and bottom trays each carrying seven 250 w. infra-red ray bulbs with gold-plated reflectors. About 20 min. are required to heat bearings to 155 deg. F., boxes remaining relatively cool. Protective coating put on bearings at the time of packing need not be washed off.

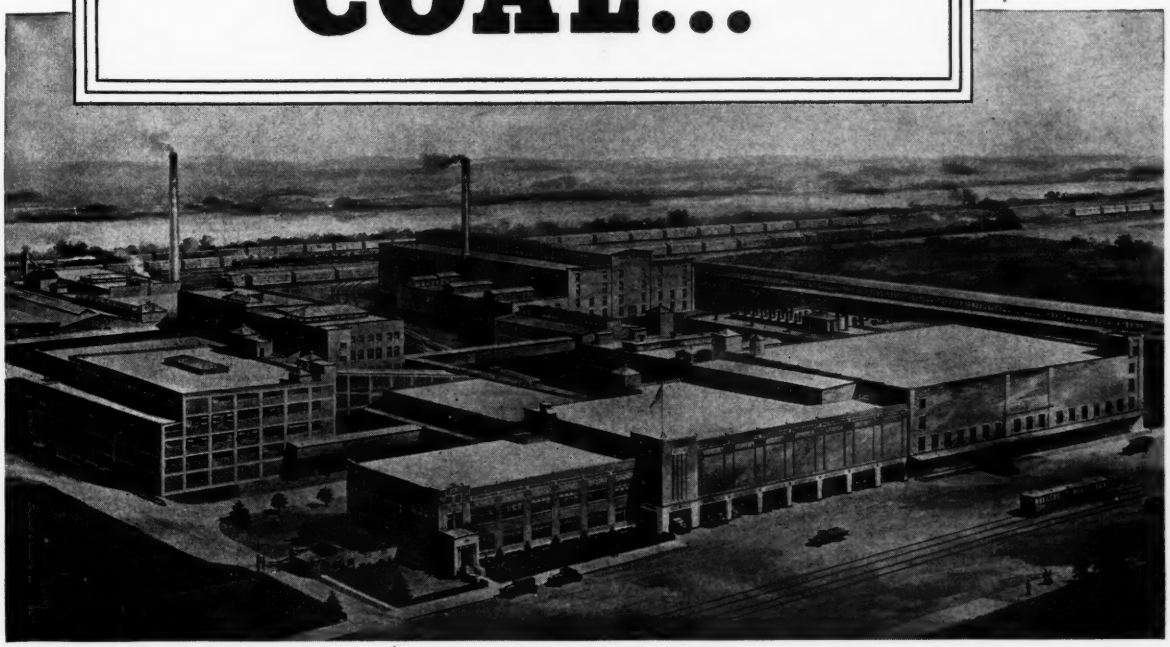
Glass Pump

FOR HANDLING hot acids or brine cooled liquids, a centrifugal pump constructed of Pyrex glass, produced jointly by Nash Engineering Co., So. Norwalk, Conn., and the Corning Glass Works, is now available in a smaller size, ¾ by 1 in. pump, with a capacity of 10 g.p.m.



These pumps are actually constructed of glass, volute case and rotating impeller for use where corrosive liquids or liquids which must be kept chemically uncontaminated are to be handled. A unique mechanical seal replaces the conventional stuffing box, and a safety unloading device eliminates the possibility of fracture of the glass casing.

"OUR PLANT OPERATES 100% ON EFFICIENT, ECONOMICAL COAL"...



. . . say E. Kahn's Sons Co., beef and pork packers of Cincinnati, Ohio.

FROM one of America's most modern plants—E. Kahn's Sons Co., of Cincinnati—comes a complete line of packing house products, headed by the famous AMERICAN BEAUTY hams and bacon. Every heat and power need of this establishment is supplied by modern, prepared COAL burned in modern equipment—at the rate of about 50 tons a day. "We have just placed an order," says Mr. August M. Flick, Plant Engineer, "for an additional 550 h. p. boiler as an auxiliary to our other three. All, of course, burn *coal*, for we consider it the most economical and satisfactory of fuels."

Let our engineers show YOU the way to power economies

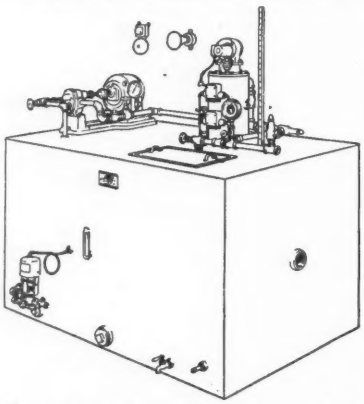
Perhaps in your plant there are opportunities to cut fuel and maintenance costs while raising efficiencies and enjoying more dependable power . . . through modern use of modern *coal*. Perhaps Chesapeake and Ohio's Fuel Service Engineers can help you. *It will cost you nothing* to find out. If you'd like our men to survey your plant, confer with your engineers and make recommendations, simply write to GEORGE H. REINBRECHT, Coal Traffic Manager, Chesapeake and Ohio Lines, 2903 Terminal Tower, Cleveland, Ohio. It's well worth a try . . . at no expense to you!

IT PAY$ TO U$E MODERN . . .

Chesapeake and Ohio Lines

Lubricating Units

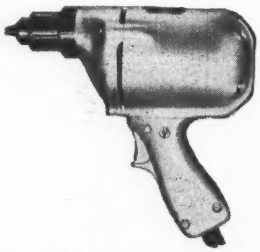
S. F. Bowser and Co., Inc., Fort Wayne, Indiana, has developed a new series of lubricating units for power plant and general industrial plant service. Known as the Fig. 829, these Self-Contained Lubricating units store the oil, pump it, filter it, and circulate



it to the machines. The units are built in a variety of sizes and types to meet all conditions. The one illustrated is a Series A-1 with a capacity of from 12 to 25 g.p.m. Other sizes and types range from a minimum of 2 to a maximum of 25 g.p.m. All models are provided with suitable indicating devices for normal operation of the system.

Portable Drill

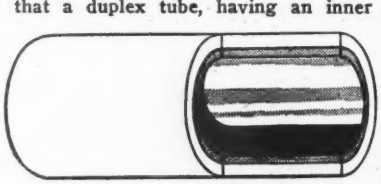
Black and Decker Mfg. Co., Towson, Md., announces a new ¼ in. standard ball bearing drill with close offset and choice of end or side handle, with



a full range of spindle speeds, drilling capacity in steel ¼ in., ½ in. in hardwood. The standard speed is 2000 r.p.m. and is available, also, in speeds of 3500 and 5000 r.p.m.

Bi-Metal Tubing

Recently announced by Bridgeport Brass Co., Bridgeport, Conn., and used for plants where heat exchanger tubes are subject to corrosion, it is found that a duplex tube, having an inner



tube of one metal or alloy, such as copper or brass, and an outer tube of a different metal such as steel will resist corrosion better than a tube of a single metal. An example is in oil refineries where steel outside resists oil vapors and, for the inside, copper for fresh water or admiralty brass for salt water meets requirements. Other combinations may be used according to the conditions to be met, such as cupronickel outside and red brass inside.

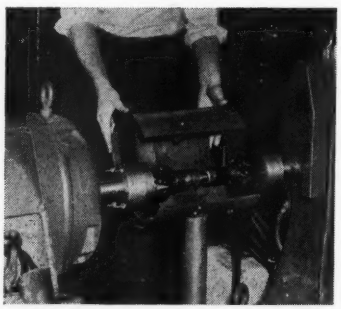
Multi-V Belts

Cincinnati Rubber Mfg. Co., Cincinnati, Ohio, has entered the field of multiple V-Belts for transmitting power with well-balanced smooth running. A heavy, elastic fabric envelope takes up outside wear, permits ready flexing and holds tightly to the groove, load being

carried by a section of high-tensile, low-stretch cords thoroughly impregnated with liquid rubber and then imbedded in a cushion of rubber. Uniform cross sections enable each bolt to seat itself in its groove, so that it will carry its share of the load.

Test Coupling

Flexible connection for speeding up changing of the coupling of motors under test, has been devised by Reliance Electric and Engineering Co., Cleveland, Ohio. Standard automotive universal joints with torque tubes shortened to 3 in. are used, with splines welded into the tube ends. Adapters



provide for bolting these joints to whatever size flange is used on the motor shaft. Joints are enclosed in ¼ in. steel cover to provide safety against a possible rupture. Lower half of the cover is welded to a 2½ in. pipe stand, the upper half being hinged, with a locking lug. A steel plate partition in the cover limits the travel of any bursted part.

Turbine Safety Control

Combined trip and throttle valves are now built into General Electric's improved Type D mechanical-drive turbines. The new safety valve will be a standard feature on all of the Type D units, which are available in capacities from 5 to 2000 hp. and in speeds from 1000 to 5000 r.p.m.

Because it provides overspeed protection similar to that on large central station and industrial units, the new built-in trip and throttle valve eliminates the shut-off previously required between station piping and mechanical drive turbines. Positive protection against overspeeding is assured because the built-in valve shuts off all steam flow automatically before a dangerous speed is approached. A reset valve, also built into the Type D turbine as an integral part, makes restarting an easy matter.

During normal operation, speed of the improved Type D turbine is controlled by a centrifugal-weight governor which keeps the governing valve constantly positioned. The governing valve is of the balanced double-seated type with renewable valve seats.

General Electric's Type D mechanical-drive turbines are of the single-stage impulse type; each wheel carrying two rows of rotating buckets. The Type D units may be arranged for either condensing or non-condensing operation with rotation in either direction.

Where continuous-duty drives are essential for driving circulating, condensate, and boiler-feed pumps, forced and induced draft fans, automatic stokers, mechanical drive turbines have become particularly desirable because their operation depends only on the available supply of steam. They also have important applications where dependable stand-by power is required for fire pumps, emergency boiler-feed pumps, exciters, and similar auxiliaries, because no preliminary warm-up is necessary and they can be put into service instantly.

Corrosion Resistant Paint

Announced recently by The B. F. Goodrich Co., Akron, O., is Koroplate, a new grade of paint developed to protect metal surfaces against chemical reactions and recommended for service wherever extremely corrosive conditions disqualify any other kind of paint or coating.

Base of the paint is Koroseal, a synthetic material created from polyvinyl chloride, which is derived by a series of chemical reactions from the common materials coke, limestone and salt.

This new paint is liquid at room temperatures and requires no heating before application. At ordinary temperatures it can be either brushed or sprayed, and can be thinned with either brush or spray thinners when necessary. It is made only in semi-glossy black.

When thoroughly dry, the new paint is extremely resistant to the action of fumes and vapors from acids, alkalies and salts at room temperatures or slightly above. It resists all acids except concentrated formic and acetic, and is not affected by brass, chrome, nickel, cadmium, zinc, copper, silver or tin plating solutions. Such solutions are not contaminated or fouled by the thoroughly dried paint, although it is not recommended for constant immersion in liquids.

Research by E. F. Houghton & Co., Philadelphia, Pa., has resulted in development of a new Okay Tred in which the surface is indented under heat and pressure to a non-skid surface, to concentrate tension on the raised portions. The treatment is also claimed to even out irregularities in thickness.

THERE IS ALWAYS "SOMETHING NEW UNDER THE SUN"

Another Example of Advantages You Get Through **READING-PRATT & CADY'S CONTINUAL DEVELOPMENT OF VALVES**

A NEW READING-PRATT & CADY WELDED BONNET GATE VALVE

Body of cast carbon molybdenum steel. Trim according to temperature, pressure and other service conditions. Assembled after bonnet weld is stress relief annealed.

It is a new Welded Bonnet Gate Valve that may solve many problems for you.

1 You can use maximum temperatures and avoid the gasket troubles and distortion that follow creep of bolts—distortion that seriously reduces valve efficiency and causes frequent maintenance jobs.

2 You get an important reduction in valve weight.

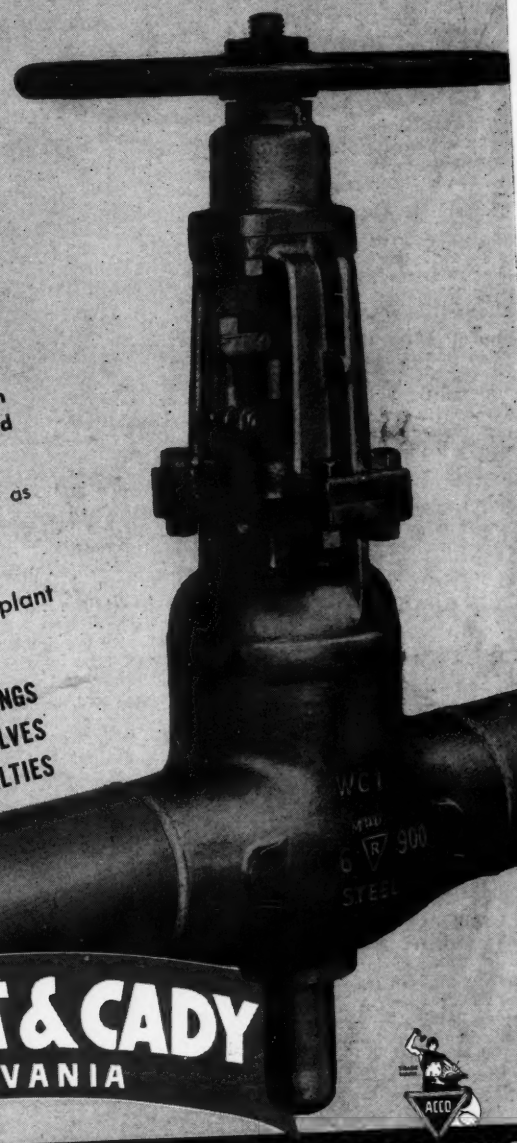
3 **Because this valve is assembled after the bonnet weld has been stress relief annealed, the stem does not pass through this final heat. Consequently the physical and chemical properties of the stem are maintained—it holds its original strength and resistance to corrosion.**

4 You can remove and replace the stem as readily as with any other construction.

•

Recommendations for service in your plant will be given gladly.

READING CAST STEEL VALVES AND FITTINGS
PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE & ENGINEERING SPECIALTIES



READING-PRATT & CADY

READING, PENNSYLVANIA

A Division of AMERICAN CHAIN & CABLE COMPANY, INC.

Manufacturers' News

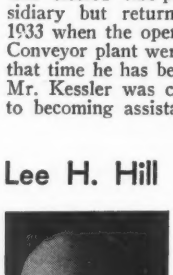
Chain Belt Elects New President

AT THE ANNUAL meeting of the board of directors of Chain Belt Company, J. C. Merwin, vice president and treasurer, was elected president of the company to succeed C. R. Messinger, who died February 4th. G. M. Dyke, assistant treasurer, was elected treasurer and A. F. Kessler, also an assistant treasurer, was elected to the new office of comptroller. Walter Kasten, president of the First Wisconsin National Bank of Milwaukee, was made a director at the annual stockholders' meeting which preceded the directors' meeting.

Mr. Merwin joined the Chain Belt organization in 1917 and has been successively superintendent, works manager, assistant to president, director, vice-president and treasurer. He is a graduate of Sheffield Scientific School of Yale University, class of 1910, and began his business career as an apprentice tool maker at the Geometric Tool Co. of New Haven, Conn. Later, he was assistant superintendent of the National Blank Book Co. of Holyoke, Mass.

Both Mr. Dyke and Mr. Kessler have been connected with Chain Belt Company since 1923. When Chain Belt acquired the Stearns Conveyor Company of Cleveland, Ohio, in 1926, Mr. Dyke was elected vice-president of this subsidiary but returned to Milwaukee in 1933 when the operations of the Stearns Conveyor plant were moved there. Since that time he has been assistant treasurer. Mr. Kessler was chief accountant prior to becoming assistant treasurer in 1938.

Lee H. Hill



LEE H. HILL has been appointed assistant manager of the Allis-Chalmers Co.'s Electrical Department. Mr. Hill has been head of the company's transformer department since 1936, and will now assume, among other duties, general supervision of the electrical department's sales promotional activities, with particular reference to developing public utility business. Mr. Hill served 2 yr. as an instructor in electrical engineering at Cornell University immediately following his graduation from that institution; then became associated with the Westinghouse Electric and Mfg. Co. as transformer design engineer and as engineer-in-charge of power transformer development. For a number of years he was manager of the transformer division of the American Brown Boveri Co., and joined the Allis-Chalmers Co. in 1931 when it absorbed Brown Boveri.

William W. Crawford

WILLIAM W. CRAWFORD, president of The Edward Valve & Mfg. Co., Inc., East Chicago, Indiana, died in Miami Beach, Florida, February 19, 1941. He was born in Washington, Conn., in 1882 and attended Beloit and Oberlin Colleges. He started his business career as newspaper man in El Paso, Texas, in 1905 and later joined the staff of the Chicago Record Herald. He was appointed manager of the Chicago Automobile Club in 1907 and in 1910 entered traction business as secretary-treasurer of the Chicago City and Connecting Railways. From 1912 to 1928 he was secretary-treasurer and director of the Chicago Interurban Traction Co. and

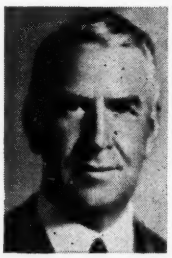
became receiver for the same organization in 1922. Mr. Crawford was president of the McClellan Refrigerating Co. from 1921 to 1928 and president of The Edward Valve & Mfg. Co., Inc., since 1923. He was a member of the American Society of Mechanical Engineers, Western Society of Engineers, American Society for Testing Materials, American Society for Metals, American Chemical Society, Society of Automotive Engineers, American Society of Naval Engineers, and Chemical Industry (British). He is survived by his widow, Mona Richards Crawford and two children, William F. Crawford and Mrs. William A. Marsteller.

Thomas J. Roberts

ACCORDING to a recent announcement by Lewis H. Brown, president of Johns-Manville, a new industrial department office has been established and will be headed by Thomas J. Roberts, formerly assistant to T. K. Mial, vice president in charge of sales. Mr. Roberts is a graduate of Cornell University and has been with the power products and industrial department since 1925.

The new office will have its headquarters at Atlanta, Georgia, and will serve the states of Georgia, Tennessee, North Carolina, South Carolina, Florida, Alabama and Mississippi.

J. J. Greene



J. J. GREENE, vice president of the Johns-Manville Sales Corp., died Feb. 27 at Avon Park, Fla., where he was on vacation.

Born in London, England, in 1878, Mr. Greene came to Canada at an early age, and later to the United States, and was educated in mechanical engineering in Toronto. Before joining the Johns-Manville organization in 1906, he was connected with the engineering firm of McMann and Taylor of New York City for four years, leaving that company to become a Johns-Manville sales representative in Albany, N. Y.

Mr. Greene was a member of the J-M Quarter Century Club, the company's veteran organization composed of men and women with 25 yr, or more of service, a member of the Mohawk Club of Schenectady, the Engineers' Club of New York and the Wykagyl Club of New Rochelle. He was also a member of the American Gas Association and the National Electric Manufacturers Association.

William Watson, vice-president and general works manager of the Allis-Chalmers Mfg. Co., announced recently the appointment of James M. White as Assistant General Works Manager. In Mr. Watson's absence, Mr. White will assume full authority over all manufacturing facilities of the company.

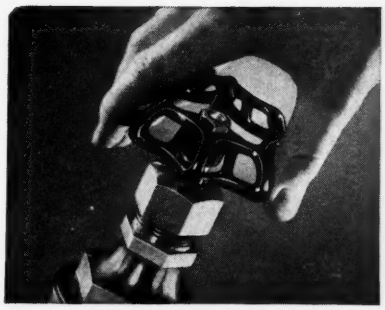
Mr. White was formerly manager of the company's La Porte Works, a post he held for the past 6 yrs. During that time he worked closely with all other company plants on special jobs to which Mr. Watson assigned him.

He was born in River Falls, Alabama, and was graduated from Alabama Polytechnical Institute with a degree in Mechanical Engineering. In 1929 Mr. White joined Allis-Chalmers and entered its Graduate Student Engineering Course, serving his apprenticeship in the West Allis Works. On completing this course he worked in various departments of the shop and in the field. In 1935 he was appointed manager of the company's La Porte Works.

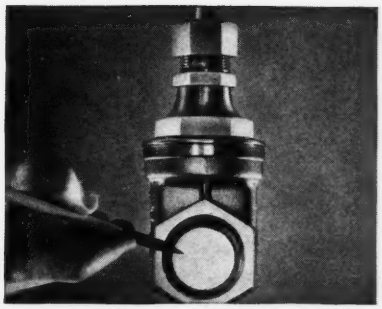
Henry G. Carter, Tampa, Fla., was recently appointed as District Representative for Copes feedwater regulators, differential valves, pump governors and allied equipment, as announced by the Northern Equipment Co., Erie, Pa.

George Goodman of Baltimore, Md., was recently appointed as exclusive representative in Maryland, District of Columbia, and northern Virginia for the Simplex Valve & Meter Co., Philadelphia, Pa. Mr. Goodman was formerly with the New York office of the Brown Instrument Co.

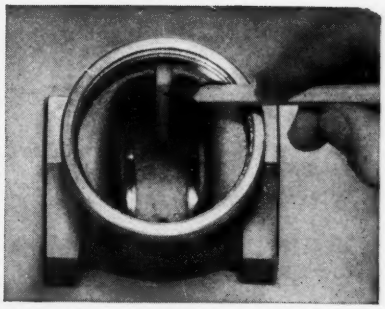
Sharp upswing in industrial activity, has necessitated moving the Indianapolis Sales Office of Cutler-Hammer, Inc., to 241 N. Pennsylvania Street, Room 316. G. E. Hunt, sales engineer, will be in charge of the Indianapolis office.



1 Start with the perfect-grip, non-heat handwheel. The ingenious deep scallop design affords a firm grip—even for greasy hands.



2 Note the clear passage through the body when valve is open. Liberally proportioned body and bonnet permit wedge to lift entirely out of line of flow.



3 Look down into the body at those full-length husky guide ribs that reduce drag on the seats and minimize chatter when the valve is partially open.

It's Easy to See

why this Bronze Gate saves you money!

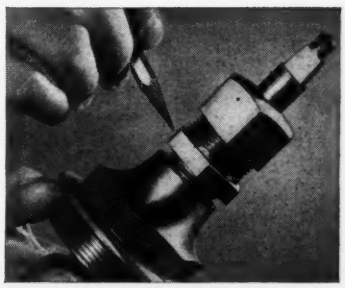
It will pay you to make this revealing study of the extra stamina features you can get in a 125-lb. Inside Screw Bronze Gate Valve—JENKINS FIG. 370.

Here are some convincing facts you should have before buying Bronze Gate Valves. The photos spotlight a few *extra* service and convenience features of Jenkins Fig. 370 . . . but for a thorough analysis, consult the enlarged section view that tells the *inside story* of Jenkins improved design and construction.

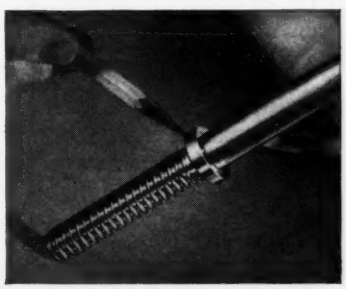
For example—extra spindle threading that insures full thread engagement with the wedge when valve is closed—for longer, trouble-free service. Notice the liberal packing box and packing gland which assure a tight joint without excessive friction on the spindle. Also—full length pipe threading in the body—to avoid injury to the seats.

In fact, you will find *every* feature of proved worth incorporated in Jenkins Bronze Gate Valves. Also made in other spindle, wedge and bonnet styles, in a wide range of pressure ratings for practically every requirement. Start getting Jenkins Bronze Gate economy now. Prompt delivery from stock at reliable supply houses everywhere.

JENKINS BROS., BRIDGEPORT, CONN.



4 Unscrew the packing box nipple and you see its ample hexagons—for full bearing with the bonnet surface—assuring a tight joint.



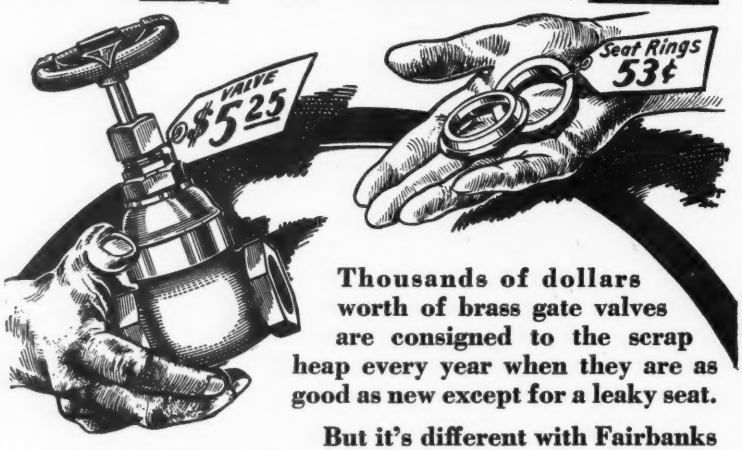
5 See the ample bearing surfaces of the spindle collar—cast integral with the spindle. Strong and liberally thick to resist thrust in making a tight seat for repacking under pressure when valve is fully open.

6 Notice how the wedge is tapered equally on both faces to assist in tight closure. Also, the deep side lugs that engage guide ribs in the body—for perfect alignment.

LOOK TO Jenkins FOR THE BEST IN VALVE DESIGN

Which Would You Rather Buy ?

A New Valve — or — Renewable Seats



Thousands of dollars worth of brass gate valves are consigned to the scrap heap every year when they are as good as new except for a leaky seat.

But it's different with Fairbanks *Renewable* Valves. They eliminate that waste.

Instead of throwing away a Fairbanks "Renewable" Bronze Gate Valve when the seat rings finally become worn, you can quickly slip in new ones—and the valve is as good as new at about 10% of what a new valve would cost. This takes only a few minutes —just long enough to unscrew the bonnet and slip in a new ring. And that can be done without removing the valve from the pipe line.

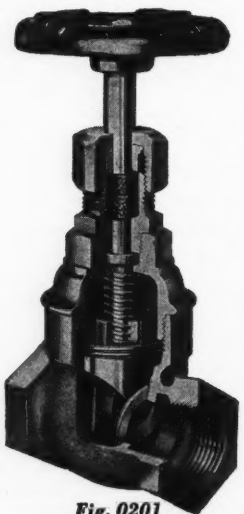


Fig. 0201
150 lbs. steam pressure

Contrast this quick, easy and inexpensive renewal with non-renewable valves that have the seats cast integral with the body.

Quick renewal is important when shutting off the steam for a long time means the shutdown of machinery for the same period.

Our valve book No. 21 contains some facts that will interest you. Write for a copy and the name of our nearest distributor.

THE FAIRBANKS COMPANY
399 Lafayette St., New York, N. Y.

Valves, Dart Unions, Hand Trucks and Wheelbarrows

Boston, Mass., Pittsburgh, Pa.

Factories: Binghamton, N. Y., Rome, Ga.

Fairbanks Renewable Valves

J. D. Wood, President of the Roller-Smith Co, Bethlehem, Pa., announces the appointment of Paul Helms as Purchasing Agent, due to the resignation of Harry A. Cassler, who held that position for the past 20 yr. Mr. Helms joined the Roller-Smith organization in 1926 as inspector, and in the production department, being appointed Assistant Production Manager in 1930. He became Assistant Purchasing Agent in 1939 and remained in that capacity until his recent promotion.

D. W. Haering & Co., Inc., Chicago, Ill., has opened several new sales offices. In Pittsburgh, Pa., Walter Peffer, is in charge of the new office at 207 Investment Bldg ; Francis Hankin & Co., Canadian affiliates has appointed R. L. Collins to its staff with headquarters at Toronto, Ont.; for Texas, G. I. Thomas, Dallas, Tex., W. E. Schaffnit is in charge of the new office at 1109 Otis Bldg.; J. V. B. Cropsey, who has been added to the staff is making his headquarters at Pomfret Center, Conn.; new office in Memphis, Tenn., is at 755 E. Gage Ave. with J. W. Gibson in charge; R. A. Jens is sales engineer at St. Paul, Minn.; Albert E. Heath has offices in Henry Clay Bldg., Ashland, Va. Increased sales and broadened service have necessitated addition of several chemists and engineers to the service organization. Promotions include H. C. Daggett, to Eastern Divisional Manager in charge of the New York City office and D. R. Walser, to Chicago Area Manager. Two engineers, E. V. Zellers and P. V. Sanders were added to the Chicago sales organization and C. La Follette was made sales manager at South Bend, Indiana. R. M. Place has been added to the staff of chemists at the Chicago Laboratory to assist in the expanded research program.

Carlton B. Smith, formerly district service engineer of Allis-Chalmers Mfg. Co. in the Southeast District, has been promoted to District Superintendent of Service and Erection with headquarters in the Healey Bldg. at Atlanta, Ga.

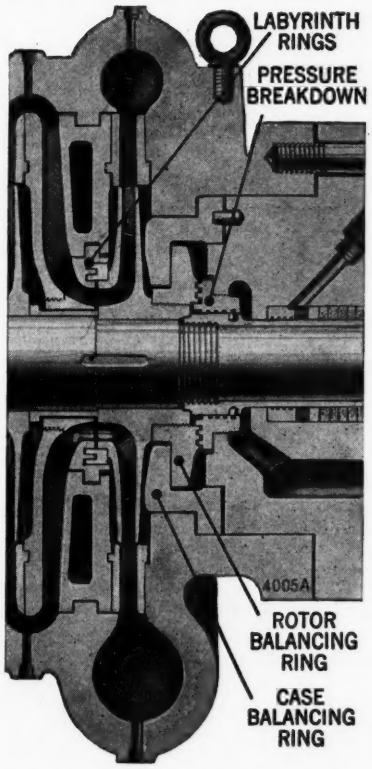
F. H. Rosencrants, Vice President of Combustion Engineering Co., Inc., has assumed responsibility for the activities of the company in the marine field, and W. H. Armacost has been designated as chief engineer of this department.

Mr. Rosencrants has long been well known in the stationary power plant where he has been associated with many important installations. A graduate of the University of Nebraska, he taught at Oregon State College from 1911 to 1916, then became mechanical engineer of the Texas Power and Light Co., and from 1918 to 1924 was with the Electric Bond and Share Co., in charge of steam station design. From 1924 to 1930 he was chief engineer of International Combustion Engineering Co., Ltd., London, England, and shortly after returning to this country was made a vice president of Combustion Enginering Co., Inc., New York.

Alan Dale, until recently representing Magnolia Metals at Chicago, has been appointed Sales Manager of the Magnolia Metal Co., with headquarters at Elizabeth, N. J.

Boiler Equipment Service Co., 686 Greenwood Ave., Atlanta, Ga., has become exclusive sales representative for

A steam plant is no more reliable than its boiler feed pumps



Section showing De Laval Labyrinth Rings and Hydraulic Balancing Device.

AS SOON as the flow of feed water ceases, the fires must be extinguished and the boilers shut down at once. Two features contributing to reliability distinguish

DE LAVAL BOILER FEED PUMPS

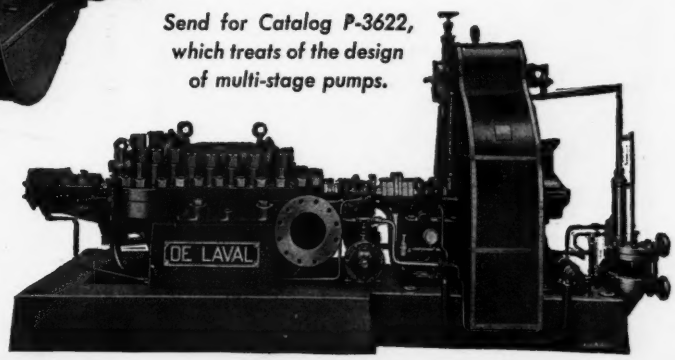
1—Labyrinth Wearing Rings, which reduce erosion and leakage at the joint between casing and impeller, while permitting ample running clearances; and

2—The Hydraulic Balancing System, which maintains the rotor in the correct axial position without dependence upon a thrust bearing and without metallic contact.

Recently, when one of twelve De Laval boiler feeders in a large central power plant was dismantled for inspection and gaging after three years of service, the original internal clearances were found to be practically unchanged, with no evidence of erosion or wear, and no renewals were required.

Send for Catalog P-3622, which treats of the design of multi-stage pumps.

● Turbine-driven pump to supply 375 g.p.m. of 228° F. water against 723 psi. gage at 3520 r.p.m. The turbine receives steam at 600 psi. and exhausts against 6 psi. gage.



● Turbine-driven six-stage boiler feeder; 850 g.p.m. of 220° F. water against 1600 psi. gage at 3550 r.p.m. The turbine is supplied with steam at 385 psi. and 650° F. and exhausts against 10 psi. gage.

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL and FLEXIBLE COUPLINGS

★ THERE'S A BELMONT PACKING FOR EVERY SERVICE ★

FOR WATER

Now that defense production is taxing plant capacities to the utmost, it's wise to take extra precautions against costly power leaks. Choose Belmont Packings for extra stamina and long-run economy.

Here are practical reasons why Belmont 319 Hollow Center Packing and Belmont 9 Special Hydraulic Packing will properly seal stuffing boxes of heavy hydraulic units such as presses, accumulators, draw-benches, squeezers and pressure pumps:

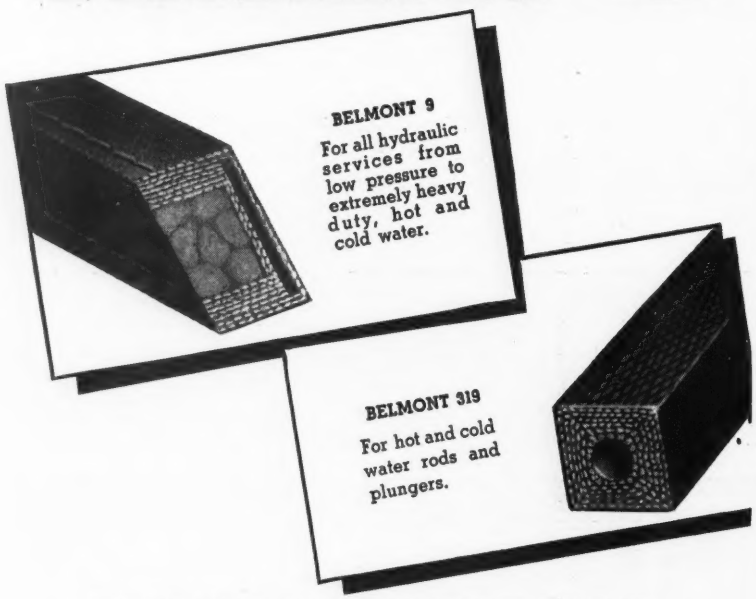
Belmont 319—(rubber and duck). The hollow center provides a point of least resistance for expansion and contraction. Hence, the packing will "breathe" toward the "hole" as varying conditions of service within the stuffing box are exerted upon it.

Belmont 9—(line flax stitched with a rubber-duck channel). This packing combines two distinctive materials made into one integral packing. The rubber-duck channel not only acts as a wiper, but as a protection to the flax. . . . These two packings used in alternate rings make an ideal combination set.

Send for Belmont Catalog No. 40 which illustrates and describes the Belmont Packing line for all services. A request on your company letterhead will receive prompt attention. Any authorized Belmont distributor will gladly show you samples and help you with your particular requirements.

BELMONT PACKINGS

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.


BELMONT 9
For all hydraulic services from low pressure to extremely heavy duty, hot and cold water.
BELMONT 319
For hot and cold water rods and plungers.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA, PA. ★

the southeastern area for refractory walls and arches made by Geo. P. Reintjes Co. of Kansas City, Mo.

F. H. Lindus, formerly Los Angeles branch manager in charge of the Service-Sales Division of the Timken Roller Bearing Co., has been transferred to the home office at Canton, Ohio, on general sales promotional work.

L. J. Halderman, branch manager of the Service-Sales Division of the Chicago office, has taken Mr. Lindus' place in Los Angeles, while Jack Gelomb, formerly Detroit Manager of the Service-Sales Division, has filled the vacancy in the Chicago office, Joe Jesseph, resident salesman in the Portland, Oregon, branch, taking Mr. Gelomb's place in Detroit.

Addison C. Armstrong has joined the Worthington Pump and Machinery Corp's. organization at its Holyoke, Massachusetts, works, as Manager of the Ordnance Division. He was formerly affiliated with the Truscon Steel Co. as a departmental manager, and previous to that, with the Bartlett-Hayward Co. and the Campbell Metal Window Corp., both of Baltimore, Md.

C. I. MacGuffie has been appointed Manager of Sales, Electric Welding Section of the General Electric Co., to succeed L. D. Meeker, now associated with the Smith-Meeker Engineering Co., New York City. Graduating from Pennsylvania State College in 1925 in electrical engineering, Mr. MacGuffie became associated with General Electric in its testing department, going to the Philadelphia office in 1928.

Lincoln Electric Co., Cleveland, Ohio, announces the appointment of Stewart J. Hieronymus as sales engineer with its San Francisco office. He was associated with Cutler-Hammer, Inc., for 12 years, and will now be associated with L. P. Henderson, manager of the San Francisco office.

William A. Cather has been elected vice-president of A. Eugene Michel & Staff, Inc., 2 Park Ave., New York, N. Y.

News from the Field

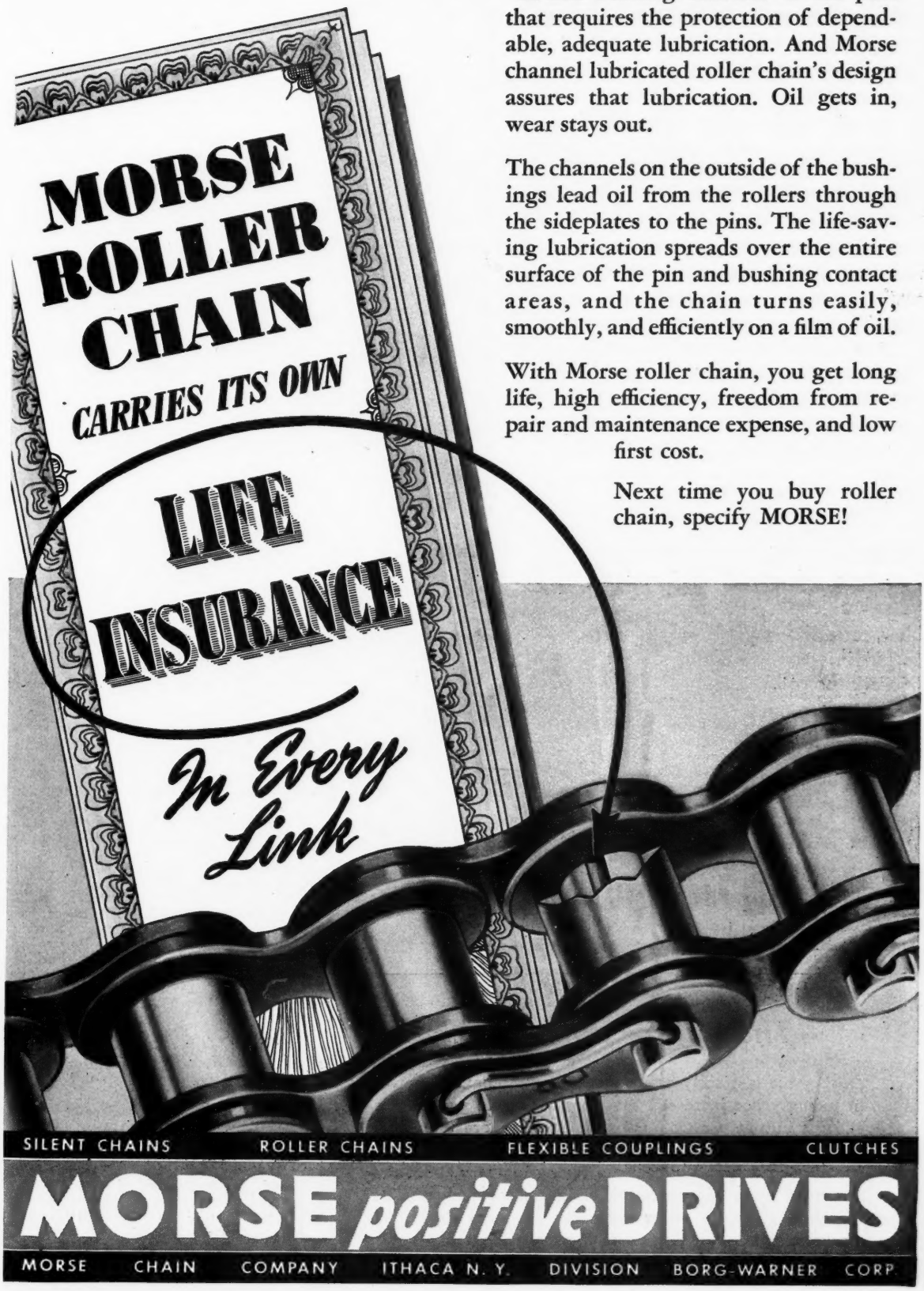
Lorenz Medal to Lee C. Wilson

THE STEEL FOUNDERS' Society of America recently awarded the Frederick A. Lorenz medal to Lee C. Wilson, general manager of the Reading-Pratt & Cady Division and Reading Steel Casting Division of the American Chain and Cable Co., Inc.

The gold medal is presented annually to the individual adjudged to have made the most outstanding contribution toward the advancement of the (steel casting) industry during the preceding year.

Program of the Midwest Power Conference

CONTINUING its purpose of offering an opportunity for all persons inter-



THE HEART of a roller chain—the pin and bushing surfaces—is the part that requires the protection of dependable, adequate lubrication. And Morse channel lubricated roller chain's design assures that lubrication. Oil gets in, wear stays out.

The channels on the outside of the bushings lead oil from the rollers through the sideplates to the pins. The life-saving lubrication spreads over the entire surface of the pin and bushing contact areas, and the chain turns easily, smoothly, and efficiently on a film of oil.

With Morse roller chain, you get long life, high efficiency, freedom from repair and maintenance expense, and low first cost.

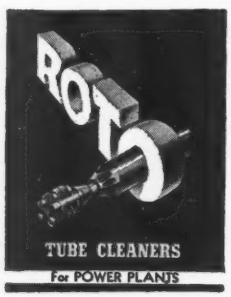
Next time you buy roller chain, specify MORSE!

NOW, More than Ever, YOU NEED the NEW ROTO TUBE CLEANER

Every time increased taxes, labor and fuel costs bite deeper into your operating profits, it becomes more urgent to equip your plant with modern time and labor saving equipment.

The powerful new Roto Tube Cleaner, with its sharp, rugged cutter heads, removes scale from your tubular equipment faster than ever before possible. The Roto Air Valve behind the motor permits one man to operate the cleaner entirely by himself. This exclusive Roto feature saves the cost of a helper and eliminates all signalling delays.

Now, more than ever, it will pay you to put the new Roto Tube Cleaner to work for you.



Model 120 cleaner for 2¼" curved tubes. Send for our illustrated bulletin describing various types of Roto Tube Cleaners for Power Plants.

The ROTO Company

145 Sussex Avenue Newark, N. J.

The Indispensable Tool

During the last sixty years the use of mechanical power in industry has increased more than fourfold per worker and the output per worker has increased more than fivefold. A large part of this progress has been due to the use of advertising as a means of telling industry about the improved ways of generating and utilizing power. The machine age means better equipment for more plants and workers, and advertising is its indispensable tool.

ested in power production, transmission or consumption to meet together annually for the study of mutual problems free from restrictions of required memberships in technical organizations, the Midwest Power Conference, which is a co-operative activity sponsored by engineering colleges and societies, has arranged an interesting program for a two-day meeting in the Palmer House, Chicago, Ill., on April 9 and 10.

Addresses at the opening session will be made by Philip Harrington, commissioner of subways and superhighways, Chicago, Ill., and Professor Huber O. Croft of Iowa University. Power Facilities and the Defense Program will be treated by C. W. Kellogg of the Council of National Defense, followed by a paper on Present Day Power Trends by Professor A. G. Christie of Johns-Hopkins University.

Alfred Iddles of Babcock and Wilcox Co. will address the luncheon meeting on Wednesday on the subject "The User Wants to Know," while the afternoon session will be devoted to Central Station Practice with a paper on Forced Circulation in American Power Plant Practice by F. H. Rosencrants of Combustion Engineering Co., another paper by C. C. Franck of Westinghouse Electric and Mfg. Co. on Modern Steam Turbine Design, and a third on Variable Speed Drives for Power Plant Auxiliaries by G. V. Edmonson of the American Blower Corp.

At a Hydro Power Session, Roger B. McWhorter of the Federal Power Commission will discuss Hydro Power and the National Emergency. At this same session the Operation of the Multi-purpose Project of the Tennessee Valley Authority will be described by Sherman M. Woodward of T. V. A. and a third paper will be presented by W. J. Rheingans of Allis-Chalmers Co. dealing with the construction of the 48,000 hp. Kaplan turbines for the Pickwick Landing Dam.

The All Engineers' dinner will be held Wednesday evening with Dr. Harvey N. Davis speaking on the subject "Priorities in Men."

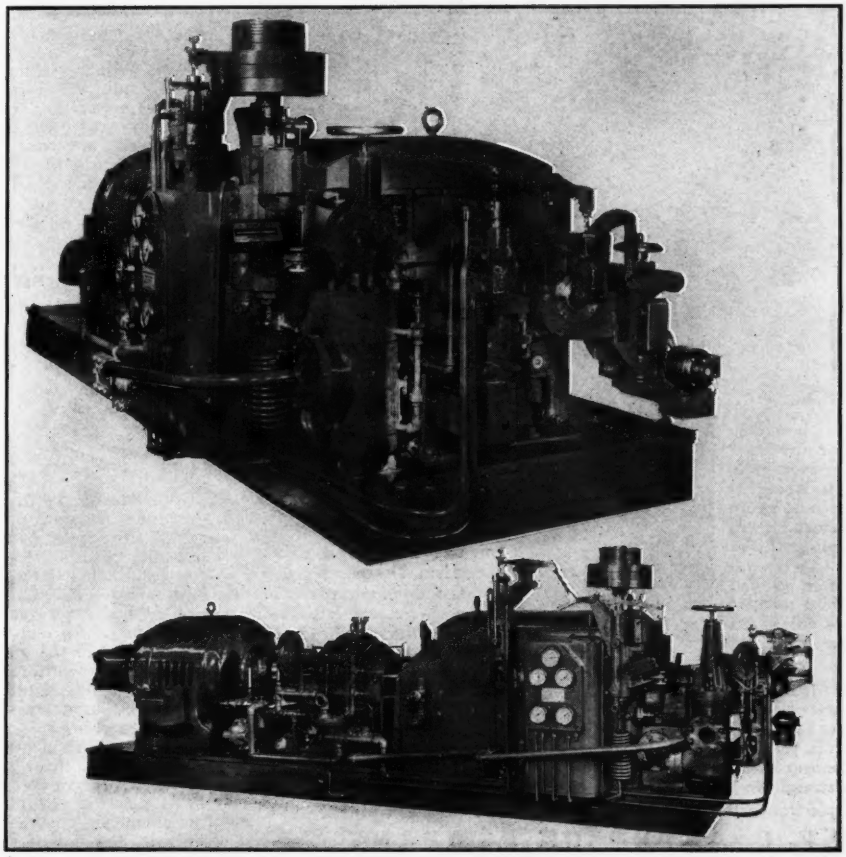
At the session devoted to Electric Power Transmission, the Limitations Placed on Power Transmission by System Stability will be discussed by H. E. Wulfing of the Commonwealth Edison Co., and Trends in Equipment Design in Relation to Economics and Defense will be the subject of a paper by W. J. McLachlan of the General Electric Co.

Industrial power plant topics have been assigned to another session at which a paper on the Increasing Power Production with Present Boiler Facilities will be given by R. S. Hawley of the University of Michigan, and another paper on Instruments and Control by Charles W. Parsons of Republic Flow Meters Co. Also at this session, John T. Davis of the Indianapolis Power & Light Co., will discuss Interchange Contracts Between Industrial Plants and Utilities.

Papers on Feedwater Treatment have been assigned to one session at which the Removal of Dissolved Gases from Boiler Feedwater will be discussed by Arthur E. Kittridge of Cochrane Corp. and Professor Frederik G. Staub of the University of Illinois will present a paper on Water Treatment Problems in the Steam Power Plant.

Aspects of the National Power Pool, Defensively and Afterwards, will be the subject of the address at the

MURRAY



Large Turbine Performance for the Small Plant

MURRAY Turbines are available to give the small plant many of the desirable operating economies enjoyed by larger plants.

The above photographs show a 175 K.W. MURRAY Automatic Extraction Turbine designed to operate with steam at 235 lb.—500 deg. F. total temperature, and to exhaust at 27 in. vacuum. Steam is automatically extracted at 60 lb. pressure.

This money saving MURRAY Turbine is installed in a midwestern packing plant.

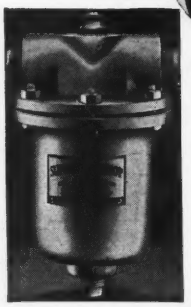
Refer your power problems to us.

Steam Specialists Since 1870

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

It's Bound to Come

Yes, we predict "It's bound to come"—that other inverted bucket traps must eventually be offered with straight-through piping because steam trap buyers are demanding it. This design is so important, so simple, so logical, so economical for the customer, so well received by the field that we predict other traps will sometime in the future bring out similar designs.



Straight-through piping for inverted bucket traps was first offered in an Anderson trap nine years ago in the Anderson Silvertop No. 11. Six years ago, all traps in the Super-Silvertop line were redesigned to include straight-in-line piping. But that's not all you get with Anderson Super-Silvertop steam traps! There's the optional elbow connection with no extra fittings—there's the guided inverted bucket that gives true engineering control to bucket motion. Also, the lever and valve mechanism that provides greater condensate capacity in a case of no greater size. With Anderson Super-Silvertop you can put a blowdown at the bottom of the trap. Besides, Super-Silvertops can be taken apart and inspected right on the line—no need to disturb pipe connections.

Get all the facts about Anderson Super-Silvertop—send for your copy of "How To Choose a Steam Trap," write today for your copy of this helpful book.

THE V. D. ANDERSON COMPANY
1939 WEST 96th STREET • CLEVELAND, OHIO

Super-Silvertop
STEAM TRAPS

Reliable Buying Bulletins

In these pages you will find advertisements of firms that make every type of machinery and equipment for generating, distributing and utilizing power. Their messages constantly record latest progress in power plant equipment. They tell you who makes it, who stands behind it. Consider their advertisements as convenient and reliable buying bulletins.

Thursday luncheon by Major Charles W. Leihy.

The Conference is also arranging for a number of inspection trips to plants of interest.

Elmer E. Woodward

ELMER E. WOODWARD, president of Woodward Governor Co., Rockford, Ill., died on Jan. He was 78 yr. old. He was the son of Amos W. Woodward, founder of the company and was the inventor of the mechanically compensated governor for water wheels, which reduced starting time from 2 min. to 5 sec. Other inventions to his credit are automatic equipment for water-wheel governors, motor-driven governor head, hydraulic governor for Diesel engines. He was chief engineer since 1899 and president since 1921, seeking always quality of products and well managed organization rather than bigness.

James H. Hurley

JAMES H. HURLEY, Terry Steam Turbine Company's oldest employee, died on February 2, 1941, at the age of 79. Mr. Hurley's connection with the turbine industry dates back to the very beginning of turbine building in the United States. In 1880 he was employed by E. C. Terry, the inventor of the Terry turbine, and helped build some of their first commercial turbines.

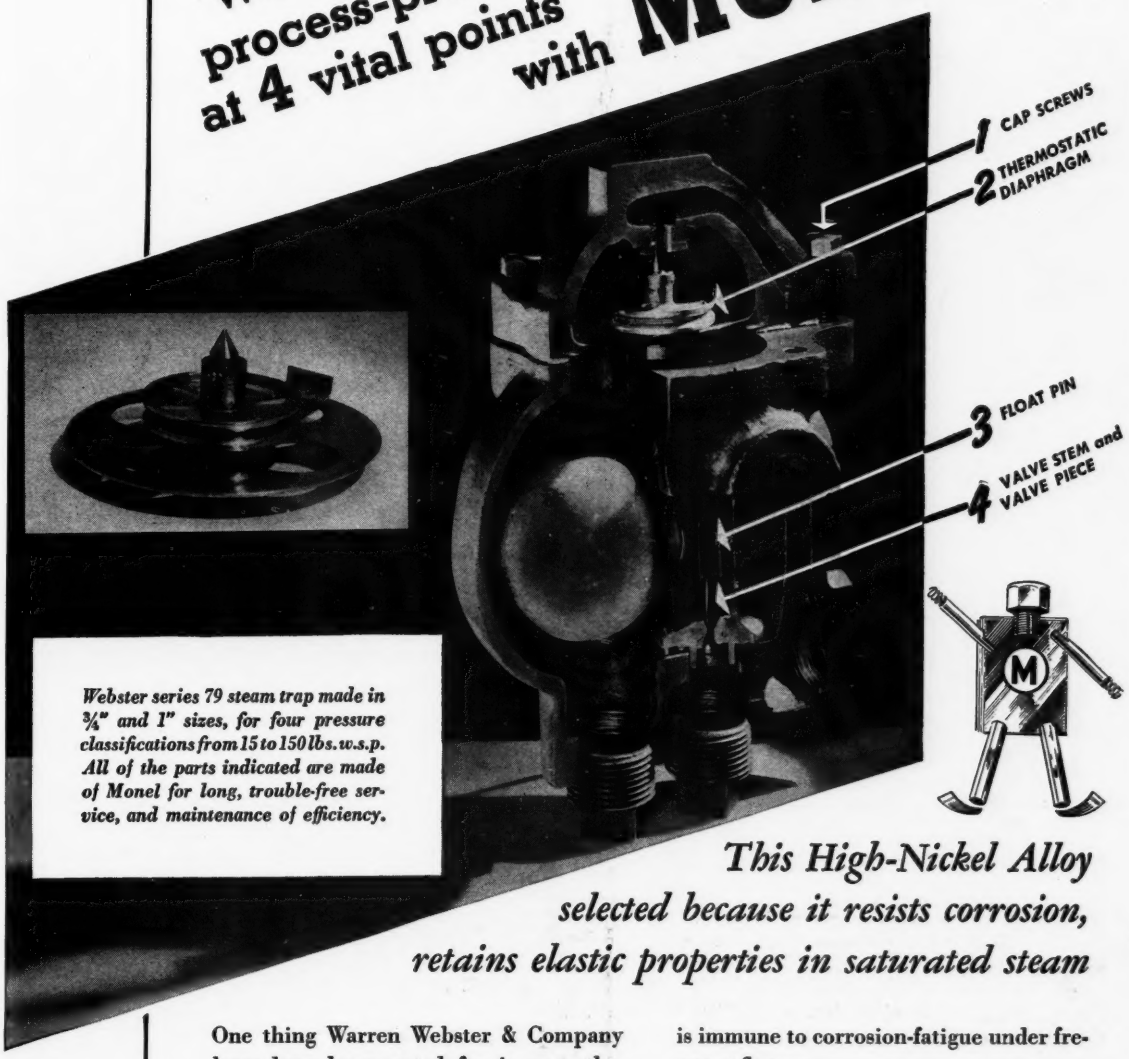
Various grades of chemical engineer positions are now open, with salaries ranging from $2600 to $5600 a year, less the retirement deduction of 3½ per cent. Engineers with experience in strategic mineral research are especially needed by the Bureau of Mines. Department of Agriculture needs persons experienced in the industrial utilization of surplus agricultural products. Separate lists will be established for various specialized branches of chemical engineering such as fuels, foods, petroleum production, and plastics.

Applicants must have completed a 4-yr. college course with major study in engineering. Professional experience in chemical engineering is also required. Appointees will perform engineering work in such fields as pilot plant investigation, design and installation of equipment, and correlation of research data in the specialized branches of chemical engineering, in which the appointments are made.

Further information and application forms may be obtained from the Secretary of the Board of U. S Civil Service Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

Laboratory mechanics experienced in fuel rating, needed by the Federal Government will be given examination by United States Civil Service Commission. The positions pay from $1,620 to $2,000 a year, less retirement deduction. Appointments will be made at the National Bureau of Standards, Department of Commerce. Responsible experience in operation, testing, or maintenance of internal-combustion engines, including experience in rating fuels with a CFR engine is required. Persons appointed as laboratory mechanics in fuel rating will make ratings of motor, aviation, and Diesel fuels and will record and tabulate test data. Applications must be filed at the Commissioner's Washington office not later

Webster fortifies process-pressure Traps at 4 vital points with MONEL



Webster series 79 steam trap made in ¾" and 1" sizes, for four pressure classifications from 15 to 150 lbs. w.s.p. All of the parts indicated are made of Monel for long, trouble-free service, and maintenance of efficiency.

This High-Nickel Alloy selected because it resists corrosion, retains elastic properties in saturated steam

One thing Warren Webster & Company have long been noted for is up-to-the-minute design. And sensitive steam line accessories like this new trap also need up-to-the-minute metals. So in order to assure continued efficiency of this unit Warren Webster uses Monel.

Large volumes of hot condensate fail to impair the operation of this Warren Webster series "79" steam trap. Especially is the sensitive thermostatic diaphragm made safe. For, even at saturated steam temperatures, Monel possesses the required elastic properties, and in addition is immune to corrosion-fatigue under frequent flexure.

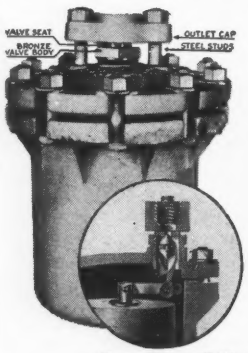
For severe conditions of power plant service, you will find among the high-nickel alloys one that meets your requirements. For parts such as those above specify Monel. In case of doubt as to which of the high-nickel alloys to use, write us your requirements.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York, N. Y.**

"Monel" is a registered trade-mark of The International Nickel Company, Inc., which is applied to a nickel alloy containing approximately two-thirds nickel and one-third copper.

Yes, They're Reversible!

The Valve and Seat of every



K-MASTER

MODERNIZED INVERTED BUCKET

STEAM TRAP

Sure, these K-Master double-life, stainless steel, heat-treated Valves and Seats are important but they are only part of the story.

Consider, too, the ease of getting at the valve assembly to reverse them—a three-minute job! This is possible because of the external assembly with ground, self-tightening joints and no gaskets.

Any vent-clogging problem you might have is eliminated by the K-Master Self-Cleaning Vent; excess air or gas by the thermo-float.

THOUSANDS OF K-MASTERS IN HUNDREDS OF PLANTS long ago proved the utility, durability and economy of this steam trap.

KAYE & MACDONALD, Inc.

92 Franklin Ave. West Orange, N. J.

Agents in Most Industrial Centers

The Voice of Business

Through their advertisements in POWER PLANT ENGINEERING alert business concerns broadcast to engineers and executives latest news on improved equipment for generating and utilizing power. Reading these messages will help keep you posted on the progress of the field and make more competent buying recommendations.

than April 17, 1941. Further information and application forms may be obtained at any first- or second-class post office, or from the Civil Service Commission, Washington, D. C.

Due to the need for engineers in national defense work, the Civil Service Commission has announced an examination to fill junior engineer positions in any branch of engineering. The salary is $2,000 a year less a 3½ percent retirement deduction. Applications will now be rated as received at the Commisison's Washington office, until December 31, 1941. Appointees will perform professional engineering work, including assisting in experimental research, design or testing of machinery, and testing and inspection of engineering materials. Separate employment lists will be established in each recognized branch of engineering. Applicants must have completed a 4 yr. engineering course, except that senior students will be admitted under certain conditions. They will not take a written test, but will be rated on their education and will be given additional credit for graduate study in engineering or for engineering experience.

Information and application forms may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

Ferry C. Houghten, Director of the Research Laboratory of the American Society of Heating and Ventilating Engineers at Pittsburgh, Pa., was awarded an honorary degree of Doctor of Science by Olivet College, Olivet, Mich., at its annual Founders' Day convocation on February 24, 1941. Dr. Houghten, born in Troy, Mich., in 1888, graduated from Olivet in 1913 with an A.B. degree, received a Master of Science degree at the University of Washington in 1915. After an appointment with the U S. Bureau of Mines, Pittsburgh, Pa., from 1918 to 1920 he became associated with the Research Laboratory of the Society and later became its director in September, 1925. He is the author of many papers in the Society Transactions and has contributed numerous scientific articles to engineering publications.

G. Bryan Shanklin, application engineer of General Electric's central station department, has recently been given a second Coffin Award from his company for gas-filled cable development. Also, Citation of Merit was recently given General Electric by the Engineering Societies of New England in recognition of Mr. Shanklin's work. Mr. Shanklin received his first Coffin award in 1932 "in recognition of outstanding ingenuity, perseverance and foresight in improving and simplifying oil-filled cable installation."

These awards are made from a fund established in honor of Charles A. Coffin, founder of the General Electric Co., to encourage and reward service in the electrical field. In addition to awards to employees, the Foundation gives recognition to lighting and power companies for improvements in service to the public and grants fellowships to graduate students for research work at technical schools and colleges.

J-M Moulded Packing Cups are made to take the toughest kind of service on all types of slow-moving pistons and rams operating against air, water, steam, oil, etc. Even against extremely high pressures and temperatures they stand up in service and assure a positive seal with minimum friction.

J-M Moulded Cups are "custom-made" . . . moulded to the exact shape and size required. Their composition can be varied to meet specific service conditions. For details on Moulded Packing Cups and on the complete line of J-M Packings, ask for the new J-M Packing Catalog. Johns-Manville, 22 East 40th Street, New York, N. Y.

JM

Johns-Manville PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

ONE reason why so many engineers favor Nicholson Thermostatic Steam Traps is because they prevent dribbling, freezing and air binding. This water sealed discharge trap is wide open and drains completely when cold—shut upon contact with steam—no chance for dribbling. And all types discharge air as efficiently as water.

Then too, Nicholson Steam Traps are extra large in capacity—two to six times greater valve area than average. Available in Bronze, Cast Iron and Cast Steel construction—in sizes from ½ to 2 in. and for pressures from vacuum to 300 lb. with superheat.

It will pay you to specify Nicholson Steam Traps regularly for improved drainage of Unit Heaters, Pipe Coils, Water Heaters, etc. Write for new Steam Trap Catalog No. 240.

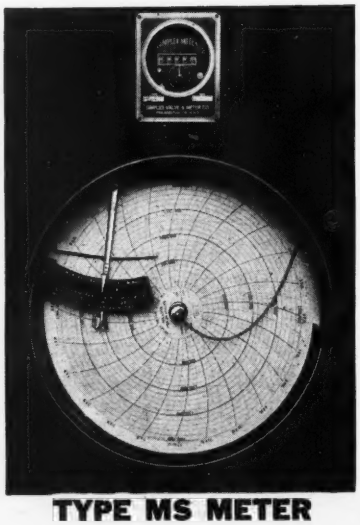
Also NICHOLSON—
Welded Floats, Piston and Weight Operated Traps, Flexible Couplings, Steam Eliminators and Separators, Compressed Air Traps.

W. H. NICHOLSON & COMPANY
160 OREGON ST. WILKES-BARRE, PA.

Gives QUICK Answers to ALL Flow Questions

HOW much water is going into steam? . . . Are boilers working at top efficiency? . . . How much gas are we using each day? . . . Let a Simplex Meter give you the quick, accurate answers to these important plant flow questions.

Simplex Meters can be used with any type of pressure producing device (orifice, nozzle, venturi tube) in any size of main to totalize the flow of Boiler Feed Condensate, Steam, Air, Gases and Corrosive Liquors. It is extremely accurate and reliable over wide ranges. And its modern price puts it within easy reach of every plant. Write for new descriptive bulletin.



TYPE MS METER

SIMPLEX VALVE & METER CO., 6790 Upland St., Philadelphia, Pa.

SIMPLEX METERS

Among the awards of Charles A. Coffin foundation of General Electric Co. for outstanding contributions to the progress of the company and electric arts, that to Horace S. Hubbard is specially noteworthy. It was for development and design of a 1,400,000 v. d.c. generator for the National Bureau of Standards in Washington, D. C., to provide power of a like capacity X-ray tube which is in use for tests and research on X-ray dosage problems. Its advantages are freedom from corona or corona ripple and capacity 5 times that of any like equipment in service. Mr. Hubbard is a graduate of the electrical department of Pratt Institute and has been with G.E. testing department since 1920.

Charles E. Wilson, vice president, Worthington Pump and Machinery Corp., Carbondale Division, reports increasing orders for refrigeration water-cooling systems for air conditioning in aviation engine and airplane plants. Four plants for North American Aviation at Dallas, Tex., will utilize 2500 t. capacity; a large engine plant will install three units with 1950 t. capacity and Packard Motor Corp. has ordered two systems of 1000 t.

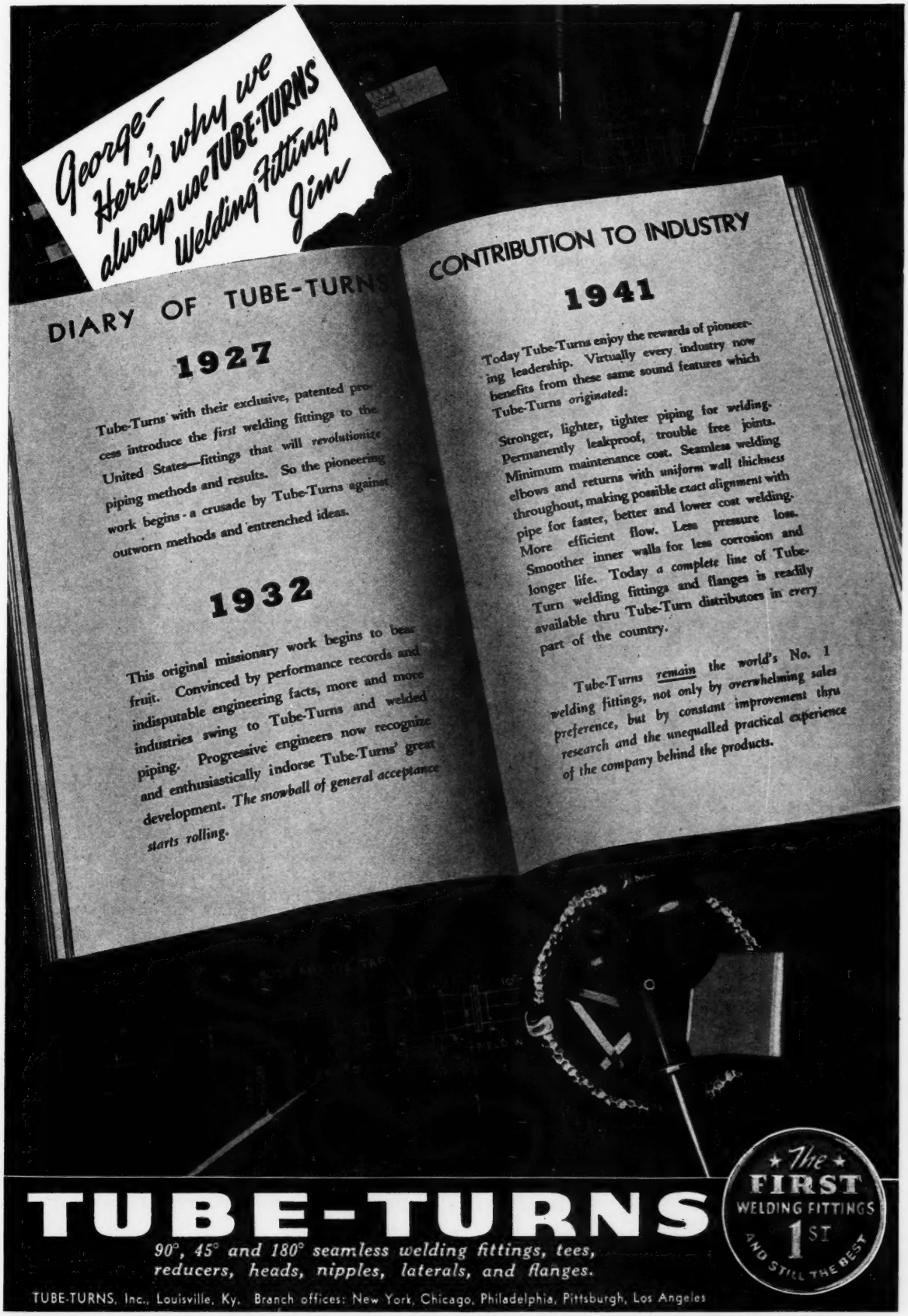
Duke Power Co. has ordered from General Electric Co. a 40,000 kw. unit for its Buck Station near Spencer, N. C., which has at present a 70,000 kw. unit, with an 80,000 kw. unit to be delivered by July, 1941. The latest unit to be delivered in 1942 will be tandem-compound, double-flow, with hydrogen-cooled generator. Steam at 825 lb. p.s i. and 900 deg. F.

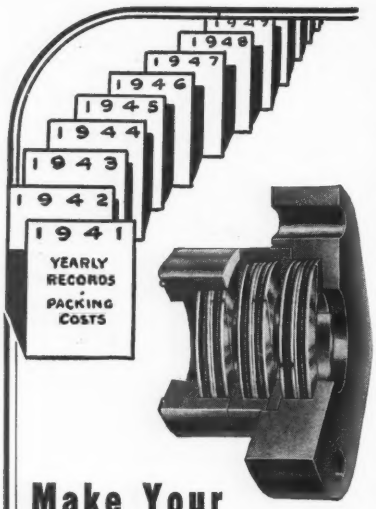
Lockwood Greene Engineers, Inc., of New York City, report contract for a pulverized fuel system for Tubize Chatillon Corp., Rome, Ga., the boiler being furnished by Babcock & Wilcox Co.; also for a boiler house plant for C. K. Williams and Co., Easton, Pa., boilers and stokers to be furnished by Edge Moor Iron Works, Inc. Plans for the plants are being prepared by the Lockwood Greene Co.

Glyco Products Co., Inc., has recently moved its plant and offices to 230 King St., Brooklyn, N. Y., to secure larger quarters for new equipment.

In the annual report of Iron Fireman Mfg. Co., T. H. Banfield, President, states that, for 1940, sales were largest in the company's history. The company has made contracts for a large amount of work on Flying Fortresses, also to make 3500 machine gun mounts a month for airplanes; yet larger stoker sales are expected for 1941.

General Electric X-Ray Corp. is to spend $450,000 in extending its plant in Chicago to keep pace with defense needs; as announced by President John H. Clough. Five-story addition to the West Jackson Boulevard building will provide space for a 1,000,000 v. X-ray equipment to test steel for gun mounts and carriages. The building will be 120 by 150 ft. Equipment will cost $75,000, the first of a number of high voltage units to be built for other corporations engaged in defense work.


George—
Here's why we
always use TUBE-TURNS
Welding Fittings
Jim
DIARY OF TUBE-TURNS
1927
Tube-Turns with their exclusive, patented process introduce the first welding fittings to the United States—fittings that will revolutionize piping methods and results. So the pioneering work begins - a crusade by Tube-Turns against outworn methods and entrenched ideas.
1932
This original missionary work begins to bear fruit. Convinced by performance records and indisputable engineering facts, more and more industries swing to Tube-Turns and welded piping. Progressive engineers now recognize and enthusiastically indorse Tube-Turns' great development. The snowball of general acceptance starts rolling.
CONTRIBUTION TO INDUSTRY
1941
Today Tube-Turns enjoy the rewards of pioneering leadership. Virtually every industry now benefits from these same sound features which Tube-Turns originated:
Stronger, lighter, tighter piping for welding. Permanently leakproof, trouble free joints. Minimum maintenance cost. Seamless welding elbows and returns with uniform wall thickness throughout, making possible exact alignment with pipe for faster, better and lower cost welding. More efficient flow. Less pressure loss. Smoother inner walls for less corrosion and longer life. Today a complete line of Tube-Turn welding fittings and flanges is readily available thru Tube-Turn distributors in every part of the country.
Tube-Turns remain the world's No. 1 welding fittings, not only by overwhelming sales preference, but by constant improvement thru research and the unequalled practical experience of the company behind the products.
TUBE-TURNS
90°, 45° and 180° seamless welding fittings, tees, reducers, heads, nipples, laterals, and flanges.
TUBE-TURNS, Inc., Louisville, Ky. Branch offices: New York, Chicago, Philadelphia, Pittsburgh, Los Angeles
The FIRST WELDING FITTINGS 1st AND STILL THE BEST



Make Your Next Packing Job

L-A-S-T!

During these days of increased production, it is especially annoying and costly to experience shutdowns due to packing trouble.

There is a solution. Install France "Full-floating" Metal Packing in your engines, pumps and compressors. The result is increased efficiency. And each job lasts for years without maintenance expense. Saves money, too, in the long run.

Installation is a simple procedure. See that the rings are installed as lettered to correspond with similar letters on the case. As simple as A-B-C.

ORIGINAL FRANCE METAL PACKING
Sold on approval
Satisfaction Guaranteed

Write for details and Catalog M-5. Make your next packing job L-A-S-T!

THE FRANCE PACKING COMPANY
Tacony Philadelphia Penna.
Branch Offices in Principal Cities

Original **FRANCE METAL PACKING**

At Endicott, N. Y., the International Business Machines Corp., will install a 500 hp. York turbo-compressor water cooling system for air conditioning a new three story building, 450 by 140 ft., to house machine shops, tool rooms and special production departments. Fluorescent lighting will be used throughout to cut down the heat load. The turbo-compressor will be driven by exhaust steam, which it is said, would otherwise be wasted, so that the cost of operation will be negligible.

Progressive expansion of its plants for mining, milling and smelting enabled International Nickel Co. of Canada, Ltd., to bring its rate of delivery of nickel, in the last half of 1940, to about double that of any previous year. The British Empire and United States are now sharing supplies of nickel, which prior to the war, were supplying the rest of the world. Immediate calls for nickel by industries are considerably larger than the supply, but demand is apparenty inflated as compared with consumption, since a large stock must be accumulated when new units for making alloy steels are put into operation. Also there is some evidence of advance orders for speculative purposes and the supply is being allocated to consumers as fairly as possible, preference being given to defense orders from the United States, Britain and Canada.

The Grove Regulator Co. has recently moved into its new modern offices and plant located at 1190 67th Street, Oakland, Calif. Embodying the very latest in plant design and construction, the new structure provides vastly enlarged engineering, production and testing facilities. According to M. H. Grove, president of the firm, the expansion is necessitated by steadily and continuously increasing business.

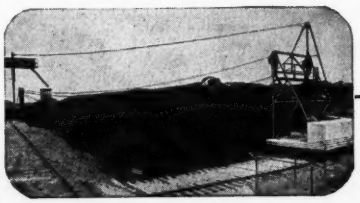
One of the features in this new factory is a complete, up to the minute testing laboratory, which is considered one of the finest of its kind. It is manned by an experienced and competent staff of chemical and metallurgical engineers. A new 10,000 lb. hydraulic testing unit and an automatically controlled testing boiler, capable of developing heat temperatures up to 1000 deg. F. and 200 lb. pressure, have been installed.

The placing of contracts for the plant of Union Bleachery, Inc., Greenville, S. C., has been announced by J. E. Sirrine and Co., consulting engineers, for a 500 hp., B & W boiler, American Engineering Co. multiple-retort stoker, two Thermix stacks for an existing and the new boiler. Also for plant extension for Renfrew Bleachery at Travelers Rest, S. C., a 400 hp. boiler and stoker plant of Combustion Engineering Co., Inc., with Link-Belt Co. conveying equipment and a Richardson Scale Co. weigher.

At the New York Safety Convention, to be held at Hotel Pennsylvania, Apr. 22-25, papers on electrical methods in defense will include: Outside Lighting to Prevent Sabotage; Accident Reduction Through Safe Lighting; Reducing Electrical Hazards in Factories; Use and Abuse of Elevators; U. S. Fire Defense Program.

SAUERMAN

Power Scrapers



Store Coal for 3c per Ton

Yes, thousands of tons of coal are moved every day at costs of 3c per ton and less, at hundreds of power plants (like the above) equipped with Sauerman Power Drag Scrapers. Economy, however, is only one of the merits of this system of storing and reclaiming coal. Simple, automatic operation is another feature. And very important is the fact that a coal pile made with a scraper is tightly packed and offers no chance for spontaneous combustion.

Write for Catalog!

SAUERMAN BROS., Inc.
486 S. CLINTON ST., CHICAGO, ILL.

Guide Posts To Buying

Reading the advertising messages that appear in POWER PLANT ENGINEERING is a profitable habit to acquire. They provide the latest information on what's new and useful in the power plant market. They serve as dependable guide posts to buying.

Certified by Service!

HERE is a representative group of Pritchard water cooling towers serving industry in widely separated parts of the country. Each tower was individually designed to fit specific conditions and to produce required results at the lowest possible operating cost. All have been certified as to correctness of design, soundness of construction and efficiency of operation by extensive, trouble free service. This record of performance is our best assurance that a Pritchard tower will serve you well.

J. F. PRITCHARD & COMPANY

DWIGHT BUILDING KANSAS CITY, MISSOURI

TULSA, OKLAHOMA; HOUSTON, TEXAS; CHICAGO, ILLINOIS; COLUMBUS, OHIO, AND ST. LOUIS, MISSOURI

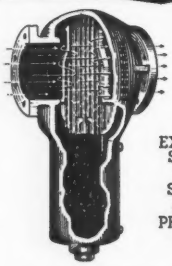
● **BULLETIN 40-A** contains all pertinent information, including details of Pritchard "featherweight", non-corrosive fans for mechanical draft towers; retriever type drift control in atmospheric towers, and other features. Write for it today.

PRITCHARD

Atmospheric and Mechanical Draft

WATER COOLING TOWERS

Use **COCHRANE**
SEPARATORS & PURIFIERS
to remove oil and moisture from steam and air

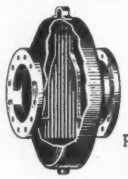


For EXHAUST STEAM
LIVE STEAM
COMPRESSED AIR

ALL-SERVICE SEPARATOR
For Horizontal Pipe Lines
For many years the most popular separator on the market. May be installed in restricted locations.

For EXHAUST STEAM
LIVE STEAM
COMPRESSED AIR

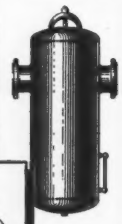
ALL-SERVICE SEPARATOR
For Vertical Down-Flow Pipe Lines
Highly practical efficient design. One-piece construction. Self-cleaning. Low in cost.



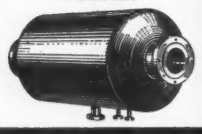
For EXHAUST STEAM
PROCESS STEAM
LOW PRESSURE LIVE STEAM

LOW PRESSURE SEPARATOR
For pressures up to 75 lb. Exceptionally large port area. Self-cleaning. Welded construction.

RECEIVER SEPARATOR



PURIFIER



COCHRANE CORPORATION
3123 N. 17th Street, Philadelphia, Pa.

COCHRANE

Cochrane Corp., 3123 N. 17th St., Phila., Pa.
Please send me copies of your Publications on Cochrane Separators and Purifiers
Name .....
Firm .....
Address .....
City ..... State .....

Dr. A. P. Colburn will deliver a series of four lectures on Heat Transmission at Purdue University, Lafayette, Ind., April 7 and 8, under the following titles: Introduction to Convection; Free Convection; Forced Convection; and Application to Design of Heat Exchanges.

Dr. Colburn, now acting head of the division of Chemical Engineering at the University of Delaware, is an engineer of wide industrial experience, a recognized authority on convective heat transfer and is probably best known for his work in this field from 1929 to 1938 as a specialist and research investigator on heat transfer for the Du Pont Company.

This is the third series of lectures on Heat Transfer at Purdue, the first: A Survey of the Success of Heat Transmission by Dr. Max Jakob of the Illinois Institute of Technology was published as Engineering Experiment Station Bulletin 68. The second: Heat Transfer by Radiation by Professor W. J. Wohlenberg was published as Bulletin 75.

Octave Blake, Jr, president of the Cornell-Dubilier Elec. Corp., announces purchase of the $1,000,000 plant of the Kendall Co. at New Bedford, Mass. This new plant will add over 250,000 sq. ft. of manufacturing floor space to C-D facilities now existing at South Plainfield, N. J., and which will continue in operation. Production at the new C-D plant was begun March 14, 1941, and deliveries have already started. Manufacturing activities will be concentrated in the main building of the new property, a modern unit of brick and steel construction with four floors.

Announcement has been made by the Stephens-Adamson Mfg Co., that the Chicago Redler Division has been moved from 360 N. Michigan Ave. to 20 North Wacker Dr., Chicago, Ill., and combined with the Chicago District Sales.

Business of the Keratol Co. has been acquired by Atlas Powder Co. and will henceforth be conducted as Lapon-Keratol Division of Atlas Powder Co., Newark, N. J. Products, organization and policies will be the same as in the past.

Thirteenth Semi-Annual Meeting of the Eastern Photoelasticity Conference will be held June 12-14, 1941, at Cambridge, Mass, under the auspices of the Dept. of Mechanical Engineering at the Mass. Inst. of Technology. Inquiries should be addressed to W. M. Murray, Room 1-321, Mass. Inst. of Technology, Cambridge, Mass.

All workers are requested to register at their nearest state employment office, giving their qualifications for any work in the National Defense Program. Those at present employed are not expected to leave present jobs unless needed for special skills, but man power is needed in aircraft, shipbuilding and machine shops and unemployed workers should be available, as need for workers is growing and the draft for military training is reducing the supply.

BUY WITH CONFIDENCE

Unless a product or service is of real benefit to the user, it cannot long withstand the glaring light af advertising.

Manufacturers of boilers, stokers, turbines, engines, pumps, piping, belting, motors and other equipment, who continue to advertise, must have products which have proved their worth by useful service. You can place full confidence in them and depend on them to deliver utmost value.

If you read the advertisements of such concerns, which are found regularly in POWER PLANT ENGINEERING, and study their messages, you can be confident of buying trustworthy power plant machinery and equipment from these progressive advertisers.

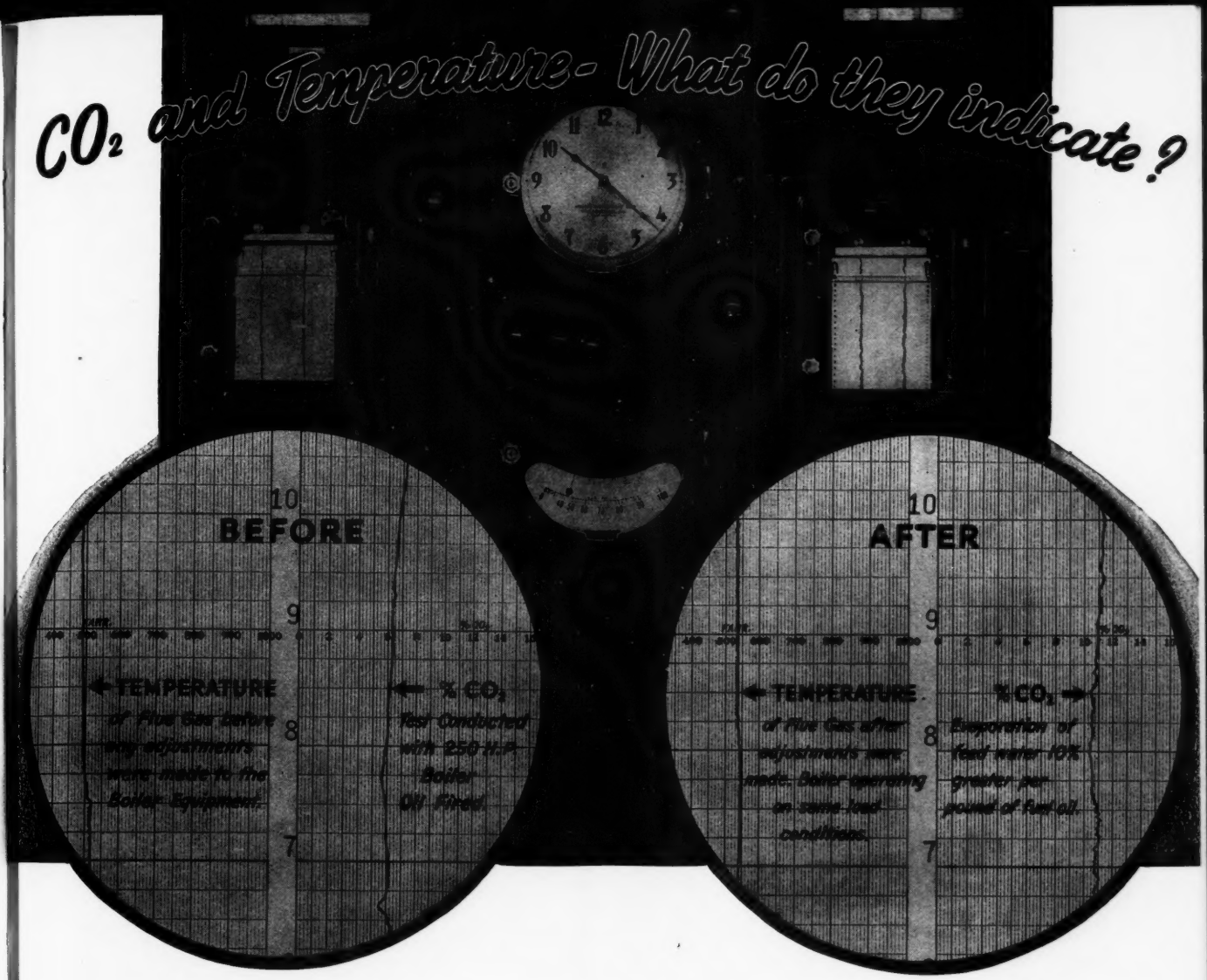
By taking full advantage, too, of the valuable installation and operation information given in the many new catalogs and special bulletins issued by manufacturers, you will gain greatly in up-to-date knowledge.

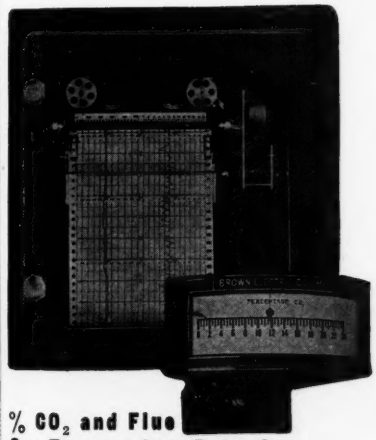
Let us know if we can help you solve any perplexing operation problems which come up in your daily work; or if you would like use to secure catalogs or data for you on any particular type of power equipment.

Address the Reader Service Department, POWER PLANT ENGINEERING. There is no charge, of course, for this service.

★ ★

CO_2 and Temperature—What do they indicate?





% CO_2 and Flue Gas Temperature Recorder

Gives a continuous record of these two important factors side by side, minute by minute, on one chart. The Indicator guides the operator in maintaining correct CO_2.

If your boiler exit gas is more than 100°F. higher than your steam temperature there is something wrong. As tubes become dirty and baffles leaky, less of the combustion chamber heat is absorbed. The extent of these conditions is indicated by the temperature of the gases as they leave the boiler and thus flue gas temperature becomes an index of boiler operation. Furthermore, when baffles begin to leak, the draft characteristics of a boiler change—a temperature that is 50°F. too high will waste hundreds of dollars in fuel on one 500 H.P. Boiler in a year—illustrating the fact that a duplex CO_2 and Temperature instrument is essential as a true index of combustion efficiency.

Where BROWN CO_2 METERS are used as a firing guide in many power plants, fuel saving pays for the installation in a comparatively short time.

The CO_2 Recorder is available to accommodate from one to six boilers, either on a full width single chart section or a divided (duplex) chart as desired.

CO_2 and Flue Gas Temperature readings may be combined on a divided (duplex) chart for from one to three boilers. Individual boilers readily identified in all cases by suitable color records.

BROWN INDICATING CO_2 METER has a readily visible scale and can be operated in parallel with a recording meter.

The gas analysis unit operates on the thermal-conductivity principle. There are no moving parts or chemicals. The CO_2 readings are transmitted electrically from the analysis unit to the indicating or recording instrument. Brown CO_2 Meters can, therefore, be located any distance from the boiler, without transmission lag.

Requiring a minimum of attention, the Brown CO_2 Meter is accurate, fast and dependable. Send for Catalog No. 3006. THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4491 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street—Amsterdam-C, Holland: Wijdesteeg 4—England: Wadsworth Road, Perivale, Middlesex—Stockholm, Sweden: Nybrokajen 7.

BROWN ELECTRIC CO_2 METERS

To Measure and Control is to Economize

On New Piping START WITH DARTS

Get off to a good start with new piping by installing Dart Unions. Darts hit the Bull's-Eye for tightness — every time. *Every time?* YES — because Darts can be used again and again. And here's *why*. They have bronze inserted seats, precision machined and ground to a true ball joint. Bodies and nuts are made of air refined, malleable iron that resists pipe strains, wrench abuse, rough handling and corrosion. Try a Dart Union *free*—it will be the beginning of a beautiful friendship.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

Sales Agents: The Fairbanks Company, New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

Work has begun on the construction of the $500,000 addition to the Sterling Engine Co. plant at 1270 Niagara Street, Buffalo, according to an announcement by Addison F. Vars, president. The new building, providing about 75,000 sq. ft. of floor space, will be ready by September and will be used for the assembling and testing of engines, now needed by the U. S. Navy and British Admirality for powering small, speedy craft such as motor torpedo boats. Robert E. Williams & Sons Co., Inc., of Buffalo, are the general contractors.

Specifications call for a three-story and basement steel frame structure, with brick and tile walls, and re-enforced concrete floors. It will be 440 ft. long and from 40 to 82 ft. in width. A one-story and basement wing is also included. A bridge over an adjoining street will connect the old building with the new.

The third floor of the new building will be used for storage of parts and sub-assembly. On the second floor will be two engine assembly lines. To make this floor dustproof, windows will be non-operating, and fresh air will be fed in through filtered ducts.

Ten testing stands will dominate the first floor, which will also accommodate the painting and shipping departments. The engines under test will be completely enclosed; they will be operated from an adjacent control room in which test recordings will also be made. The engine test cells will be treated for both sound transmission and sound absorption.

The building will also provide office space for the plant foreman and Army and Navy inspectors assigned to the plant. Shower rooms for workmen, lockers, lunch space and first aid quarters will also be provided. Fluorescent lighting will be employed throughout the first and second stories.

Frederick T. Williams, vice president of the contracting firm, states 160 working days will be required to complete the project. This, he indicated, represents a construction schedule 40 to 50 percent faster than normal.

George B. Smyth is the architect. Thomas H. McKaig is the consulting engineer and C. A. Cherry the mechanical engineer.

Robert E. Williams & Sons Co., Inc., have been contractors for many well-known educational, church, office and industrial buildings in and about Buffalo.

To fill a need in the national defense program of the Navy Department for inspectors of aeronautical engineering materials, United States Civil Service Commission has announced examination covering several branches of aeronautical engineering, the salaries ranging from $1,620 to $2,600 a year, less retirement deduction. The maximum age for these positions is 65 yr. Applicants must have had experience in inspection or testing of engineering materials to determine compliance with specifications or standards of manufacture. Experience in the manufacture of precision instruments may be substituted for part of the inspectional experience. Also, each year successfully completed in resident study in an engineering, metallurgical, or technological course may be allowed for part of the experience. Branches for which experience need not have been acquired on aircraft work are: engines, mechanical parts, instruments, tools and gages, and materials. Three options in which persons may qualify are aircraft, aircraft propellers, and parachutes. For all options completion of a training course of the U. S. Office of Education in materials inspection and testing for making inspection of general mechanical engineering materials will be accepted for 1 yr. of the required inspectional or testing experience.

Applications will be rated as received at the Commission's Washington office until further notice. Further information and application forms may be obtained at any first- or second-class post office, or from the Commission.

New Engineering Books

Careers on Business Papers. By Benn Hall. Published by Duell, Sloan & Pearce Inc., 270 Madison Avenue, N. Y. 5½ x 8½ in., 268 pages, cloth bound. Price $2.50.

For those interested in the business paper, or publishing field (including house organs) this is not only an instructive but a very interesting book. Written by a former editor

Before you order "SPECIAL" Automatic Valves

CHECK with DAVIS!

RIGHT now many engineers are faced with a problem. To get the kind of performance they want involves SPECIAL design and construction in the equipment going into power, process and heating jobs; but to get quick delivery and reasonable costs, wisdom dictates use of STANDARD items wherever possible.

It is in such situations that DAVIS can immediately come to your assistance with what is believed to be the broadest line of automatic valve specialties in existence today. Features which you might consider "special" are often found to be standard with DAVIS, making unnecessary a long wait for special equipment to be designed and built. *For your own protection, always make it a habit to check with Davis on any automatic valve need!*

Do you have the latest **DAVIS** *Bulletins Handy?*

DAVIS REGULATOR CO.
2508 S. Washtenaw Ave., Chicago

Without obligating me, please MAIL literature describing:

- ☐ Pressure Regulators and Pump Governors (including service and capacity charts).
- ☐ Pressure Relief, Back Pressure, and Exhaust Relief Valves.
- ☐ Liquid Level Controllers for closed tanks.
- ☐ Lever and Float Operated Valves.
- ☐ Solenoid Valves for industrial service.
- ☐ Stop and Check, Non-Return and Balanced Check Valves.
- ☐ Strainers.
- ☐ A specific problem is outlined on the attached sheet. We would appreciate your recommendations.

Name .....

Company .....

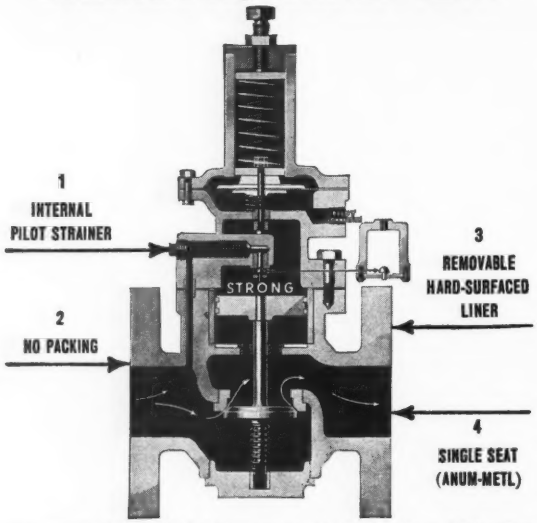
Street .....

Town ..... State.....

PIPEWRENCH PETE SAYS:

NOW—You Can Regulate Pressure to a Gnat's Eyelash!

4 Trouble-Saving Features In STRONG'S Supersensitive Valve!



How STRONG'S Type "C" Valve Works

High (inlet) pressure forces piston down, opening valve and admitting pressure to reduced (outlet) side. When reduced pressure reaches point valve is set to maintain, diaphragm is forced up, closing pilot valve, and shutting off high pressure to piston chamber. As pressure in piston chamber decreases, bottom spring and steam velocity close main valve.

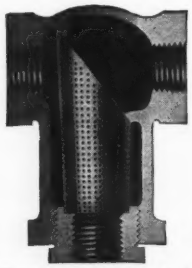
In actual operation, valve automatically adjusts itself to meter the volume of steam, air or gas required to maintain the reduced pressure.

Long, Trouble-Free Life

Because of its simple, sturdy construction, the STRONG Type "C" regulating valve meets the need for accurate, trouble-free pressure regulation.

Write about your pressure reducing problems or for Catalog 154.

QUICK CLEANING STRAINERS



Regular semi-steel, suitable for pressure to 250 lbs. or 400 degrees. Pressure-cleaned by removing bottom plug or opening valve. Install ahead of reducing valves, etc.

The Strong, Carlisle & Hammond Co.
1392 West Third St., Cleveland, O.

STRONG
STEAM SPECIALTIES

in collaboration with a large number of men active in the industry, the book is divided into 16 chapters, the first eight cover the history of business papers, and the detailed organization of various departments such as, advertising, circulation, editorial, co-operation between departments, etc. Several chapters are devoted to the opportunities in the business, how to get a job, how to succeed, etc., while later chapters are devoted to editorial work including free lancing for writers, photographers and artists. The last chapter gives a comprehensive list of business paper publishers.

Thermodynamics. By H. A. Everett. Published by D. Van Nostrand Co., Inc., 240 Fourth Ave., New York, N. Y. Size 6 by 9 in., 455 pp., cloth bound. Price $3.75.

This is a second edition written, by the head of the mechanical engineering department of Pennsylvania State College, as a comprehensive course for students in engineering colleges. While covering the generally accepted subdivisions of thermodynamics, i.e., theory and laws, gases, vapors, fluids, refrigeration and application of theory to actual machines, the book is notable chiefly for its logical arrangement, simple and effective illustrations and clarity of expression so often lacking in books on this subject. It also places particular emphasis on the kinetic theory explanation of heat, which is particularly useful in giving a tangible picture of thermodynamic phenomena.

As such it is an excellent book for reference or review purposes and its value for this purpose is further enhanced by two chapters, one summarizing the relatively few fundamental concepts in general form, the second doing the same thing for general mathematical relations. While clear, the treatment, intended as it is to be supplemented by class work, is sometimes too brief for the beginner, studying alone, to follow easily without outside assistance.

The second edition differs from the first mainly in the emphasis placed on the continuous flow principle in connection with the heat engines, revisions of the approach to fluid flow considerations and new spectroscopic data on the specific heat of gases at high temperature.

A.S.T.M. Supplements. Published by the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa. Size 6 by 9 in., cloth bound. In three parts. Part I, 478 pp.; Part II, 348 pp.; Part III, 573 pp. Price $3 for any one part; $5 for any two parts; $7 for three parts. Half leather binding $1 extra per volume.

Under the arrangement started last year the A.S.T.M. Standards are published triennially, with annual supplements to keep the standards up to date. The 1940 Supplement was recently issued, with some 292 specifications, tests and definitions issued for the first time in 1940 and revised during the year.

The supplements are divided into three volumes so as to agree with the book of standards. Part I on metals with 100 new standards covers ferrous and non ferrous metals. Part II, with 91 standards, covers non-metallic materials for construction such as cement, concrete, gypsum, refractories, glass, etc. Part III, general non-metallic materials is the largest volume and covers coal and coke, petroleum products, electric insulating products, plastics, rubber textiles and paper.

Applied Heat Transmission. By Herman J. Stoever. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York City. Size 6 by 9 in., 208 pp., cloth bound. Price $2 50.

While heat transfer is not a subject well adapted to simple treatment, the author has done a credible job in presenting certain phases of it in a usable form, well illustrated by example. Conduction and radiation are dealt with briefly but the main section, concerned with convection, convection heat transfer coefficients, and calculation of pressure drops with practical applications and design charts, is in considerable detail. This section is particularly well illustrated by examples worked out to show the methods of application. A third section of the book covers the practical aspects of commercial heat exchange design and the application of insulation for the reduction of heat losses from piping, heaters, boilers and other hot surfaces. As before the application formulas are illustrated by problems, solved in detail. The author is associate professor of mechanical engineering at Iowa State College, Ames, Iowa.

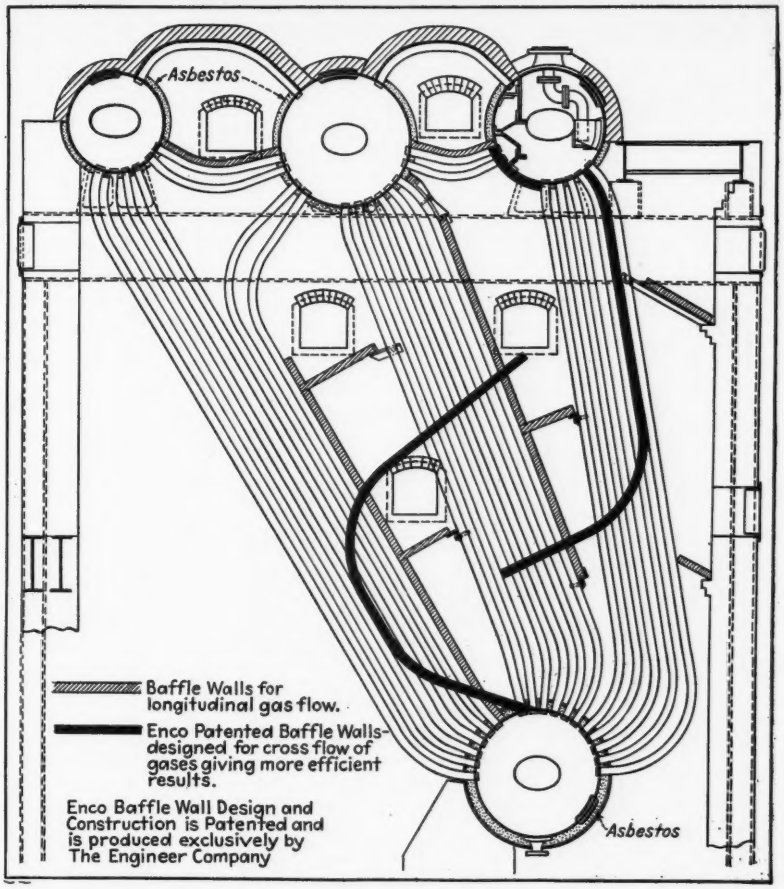
Men and Volts, the Story of General Electric. By John Winthrop Hammond. Copyrighted 1941 by General Electric Co., published by J. P. Lippincott Co., New York City. Illustrated, 6 by 9 in., 436 pages. Price, $2.50.

Reading almost like an unbelievable novel, this book is extremely interesting from start to finish. The author caught the vision of an immense electrical industry in the making

Increase the steam output of your boiler by eliminating the bottle-neck caused by faulty baffle wall design and construction

Enco Patented Streamline Cross Flow Baffles provide a wide open throat into the first pass and quick transit across the first, second and into the third bank of tubes. This assures the quick transfer of the hot gases from the furnace to intimate contact with tube surfaces, maintaining a hot boiler and lower furnace temperature. It also permits a higher steam capacity within flow points of furnace linings.

All gas passages are tapered and reduced in area to conform to the reduction in volume of the gases as they cool in passing over the heating surface. By this method the velocity and the heat transfer are maintained and the draft loss caused by faulty baffle walls having a succession of narrow openings (bottlenecks) is avoided.


Asbestos
Baffle Walls for longitudinal gas flow.
Enco Patented Baffle Walls-designed for cross flow of gases giving more efficient results.
Enco Baffle Wall Design and Construction is Patented and is produced exclusively by The Engineer Company
Asbestos

By Streamlining and Curving the Baffles, a wide flexibility in design to suit various tube and superheater arrangements is possible. Dead gas pockets are eliminated and the entire heating surface is covered more effectively, permitting higher rate of heat transfer.

All Enco Baffles are built gas tight with uniform thickness and smoothly curved surfaces to eliminate angles and avoid eddy currents, promoting the smooth flow of the gases over the heating surface. There are no pockets to collect cinders or fly ash, permitting the soot blowers to work more effectively.

Greater cleanliness of the heating surface increases the output for the same fuel consumption and the reduced use of soot blowers means material saving of live steam.

●

There are many more worthwhile features in the design and Construction of ENCO BAFFLE WALLS for Water Tube Boilers which are described in Bulletin BW-40. Write for your copy.

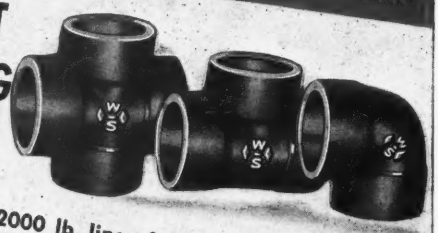
Enco Patented Cross Flow Baffles are produced exclusively by

THE ENGINEER COMPANY

75 WEST STREET — Enco Streamline Baffles — NEW YORK, N.Y.

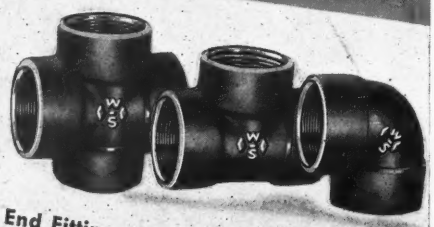
Lightweight
FORGED STEEL
FITTINGS

SOCKET WELDING



The new 2000 lb. line of W-S Socket Welding Fittings, while light in weight, possess exceptional strength. They are installed with greater ease and speed, and make better joints. Just slip the fitting over the pipe end and make a clean outside-the-pipe weld.

SCREW END



W-S Screw End Fittings for 2000 lb. service are compact and light. Threads are accurately cut and perfectly aligned. Uniform wall thickness throughout assures a high factor of safety. Long low bands afford a better wrench grip—provide added strength.

W-S Socket Welding and Screw End Fittings are available in a complete range of types and sizes for pressures up to 6000 lbs. Specifications, dimensions and prices are listed in Bulletin A-3—Write for a copy—

THE WATSON-STILLMAN CO., ROSELLE, N. J.

WATSON-STILLMAN

as the facts in regard to scientific discoveries, research work carried on by numerous investigators, patented devices and equipment, litigations among rival concerns, to say nothing of the initiating personalities that have guided the destiny of volts through the past three-quarters of a century, made themselves known to him during the 3 yr. he spent in collecting historical material for this volume prior to his death in 1934. His portrayal of how scientific toys have been put to work by industry is not only interesting from a historical viewpoint, but fascinating reading in the light of present information. The author's manuscript, which closed with the year 1922, was worked into publication form by Arthur Pound. Highlights of the major achievements in the succeeding years have been briefed in an Epilogue by Philip D. Reed and Charles E. Wilson, and in an appendix Owen D. Young gives a statement of the formation of the capital of the General Electric Co.

Historically Mr. Hammond divides the electrical industrial development into eight distinct periods which are treated under the following general headings: The Creative Period of the Arc Light and the Incandescent Light; The Period of Commercial Introduction of Electric Lighting; Electric Transportation, Motors, the Transmission of Power; The Period of Expansion and Consolidation; The Formation of the General Electric Company; The Development of Big Generating Units, Beginning of Hydroelectric Projects, Expansion of Systems through Transmission; The Development of Steam Turbines, Start of Industrial Research and of Commercial and Financial Expansion; and Spectacular Applications and Discoveries, Continued Expansion, Birth of Radio, Major Achievements—Marking the End of the Pioneer Period.

Men and Volts is a modern book with such intriguing chapter headings as: Miniature Moons, Transplanted Pioneering, Broomstick Cars, Destiny Comes to Town, A Famous Fight, Experts on the Job, Steam Locomotive Challenged, Romance at Work. There are forty-one of these chapters, each relating incidents in the development of a great industry and all of them of absorbing interest to the engineer or industrialist.

Crosby-Fiske-Forster Handbook of Fire Protection, Ninth Edition; Robert S. Moulton, General Editor; published by the National Fire Protection Association, Boston, Mass.; semi-flexible imitation leather cover, 1300 pages, 4½ by 6½ in.; copyrighted 1941; price $4.50.

This compilation of condensed information on fire prevention represents the work of more than a hundred authorities in the various branches of the fire protection engineering profession. In this ninth edition many of the sections are entirely new, among these is detailed information on fire hazards with air conditioning systems, a chapter on mine fires and explosions, data on special extinguishing systems and other equipment that has come into special and general use since the last edition 5 yr. ago. The table of properties of flammable gases and solids has been thoroughly revised. The chapter on electrical hazards now contains valuable information on static charges. Automatic sprinkler systems come in for several chapters. Statistics are brought up to date. Engineers will find this handbook extremely helpful in laying out fire protection systems and selecting equipment as it deals with all industries, is clear and concise in statements, and is thoroughly indexed.

Power Factor Problems in Electricity Supply, by G. W. Stubbings. Distributed by Chemical Publishing Co., Brooklyn, N. Y., 1940, 175 pages, 5 by 7½ in., price $3.50.

While this book is elementary in the method of presenting the subject of power factor, it leads the reader by easy stages to the point where he can carry through the necessary calculations for power factor correction in electrical supply lines. Mr. Stubbings is an electrical engineer and has written a number of books on electrical subjects, published, as was this one, in Great Britain. Except for the fact that some abbreviations are not according to American standards and cost calculations are in British money denominations, the explanations are clear and concise, and the information is applicable to conditions in this country.

The author has effectively carried out his intention to give a simple account of power factor, its meaning and the causes of its variation, its effects on the cost of and the charges for electricity supply, and the ways in which it can be artificially changed. Fully worked out numerical examples are used to illustrate the quantitative aspect of power factor problems and considerable attention is given to the economic phases of power factor correction. Advanced mathematics have been eliminated in the treatment, as the book is intended to be of use to operating engineers and purchasers of power from supply lines.

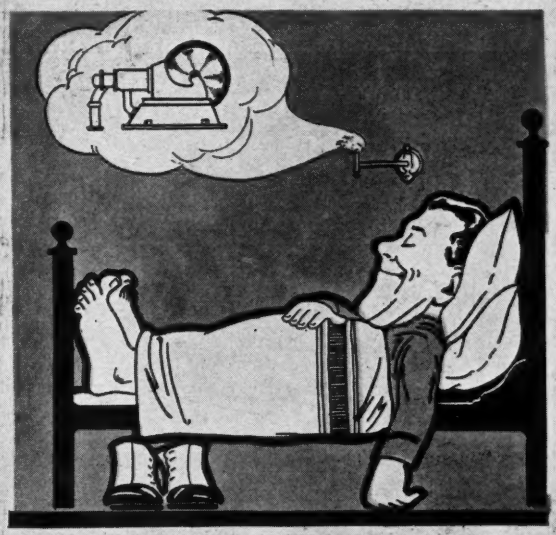
RIMES & RINKLES OF 1909

By De La Vergne

When day is done he shuts the valve,
And quickly hies him hence.
No fires to bank; No coal to burn
Through the long night without return,
With these Oil Engines De La Vergne.
They're built to save expense.

Report from Albany Hardware Specialty Mfg. Co., Albany, Wis.
January 11, 1909.

"We recommend your engine for the reason it is very economical in fuel consumption. The cost to ... er which we formerly u...



Our man each night enjoys the rest
His daily labors earn.
For him no midnight toils and cares;
He knows how well his engine wears.
They run for years without repairs,
These Engines De La Vergne.

Report fro... Library, Southport, Conn.
January 29, 1909.

"Your Engine ... 1898. It has never needed a single ... fect satisfaction and ease."

These pages, reproduced from an early De La Vergne advertising piece, indicate the important part played by De La Vergne in the development and promotion of oil engines. De La Vergne diesel engines of today incorporate the cumulative result of forty-eight years of research and development.

Baldwin De La Vergne SALES CORP.

SUBSIDIARY OF THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA

BLW THE BALDWIN GROUP

This is No Time to Risk

Power Failure

Safeguard boiler water levels with Reliance ALARM and EYE-HYE

Positive Supervision of water levels prevents costly accidents—

shut-downs and loss of production

YOU men who shoulder the responsibility in the power plant will agree that every means of guarding against power failure is justified these days. Make sure your boiler water levels are checked unfailingly. The Reliance Safety Team gives both SOUND and SIGHT supervision — *dependable* check against dangerous or inefficient water levels • Up on the boiler drum the Reliance ALARM sounds instant warning when water levels go too high or too low — by shrill whistle or by as many electric signals as needed to reach attendants, wherever they may be • EYE-HYE carries the true water level reading, in a brilliantly illuminated green indicator, to men on the boiler room floor. Saves time — induces more frequent reading • Don't take chances on *power failure.* For absence of concern over water levels, make doubly sure with the Reliance ALARM and EYE-HYE. *Write for free ALARM and EYE-HYE bulletins.*

THE RELIANCE GAUGE COLUMN CO.

5902 Carnegie Ave., Cleveland, Ohio

Reliance

Boiler Safety Devices since 1884

Generating Stations. Economic Elements of Electrical Design. By Alfred H. Lovell. Third Edition, 471 pages, illustrated. Cloth, 6 by 9 in. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y., 1941. Price $4.50.

Since the publication of the second edition of this book in 1935 there have been many changes in generating stations. Particularly within the past year as a consequence of defense activity there has been an intense drive for rapid increase in the total power capacity available for service. In the hydroelectric field, a single manufacturer had more than 1,000,000 hp. in waterwheel-driven generators under construction at the end of 1939. In the steam field the development of better metals has permitted thermal cycles to advance decisively to new high pressures and temperatures with pioneering installations planned at 2400 lb.

This third edition of this book therefore has endeavored to cover these, developments and much new and valuable data is presented. Chapter headings are as follows: 1. Elementary Principles of Corporate Finance. 2. Cost of Stations. 3. Economic Decay. 4. Power Plant Load Curves. 5. Economic Conductor Section—Power Distribution Systems. 6. Power Plant Location. 7. Bus Systems and Current Limiting Reactors. 8. Circuit Breakers and Their Applications. 9. Introduction to Single Phase Short Circuits. 10. Protective Relays and Their Application. 11. Transmission Lines with Synchronous Condensers.

Playing With Lightning. By Dr. K. B. McEachron in collaboration with Kenneth G. Patrick. First Edition. 232 pages, 5½ by 8½ in. Cloth. Random House, N. Y. 1940. Price $2.50.

This book is lightning's definitive biography. It can also be called a scientific detective story, telling of the unmasking and shackling of the most violent and destructive criminal of all time. Written in a popular vein, with technical terms held down to a minimum this book presents an accurate and interesting study of lightning. Both Dr. McEachron and Mr. Patrick are with the General Electric Co. Dr. McEachron is the Director of the G. E. High Voltage Laboratory in Pittsfield, Mass. and was in charge of G. E.'s "Lightning Show" at the New York World's Fair. It was he who designed the generator which hurled its spectacular thunderbolts for thousands of visitors.

FOR THE ENGINEER'S LIBRARY

Coupon for obtaining free literature listed here may be found on page 145, under the heading Helpful Bulletins.

Valves, Instruments and Controls

1 Valves—A 12 pp. bulletin, 8-B, features late models of standard and wafer type butterfly or blast gate valves for the control of air, gas, steam and liquids, also interesting data and illustrations for both manual and automatic control by means of air and electric motors, solenoids, air and hydraulic cylinders. R. S. Products Co.

2 Bronze Valves—An 8 pp. bulletin No. 4-4500D, features Hancock Superfinished "500 Brinell" Bronze Valves in descriptive application of the superfinish operation and resulting increase in wearing quality. Hancodur stems and bonnets are also described. Hancock Valve Division of Manning, Maxwell & Moore, Inc.

3 Thermometers—A new 72 pp. plastic bound catalog on Industrial Thermometers has been recently revised and brought up to date by including recent additions to the American Thermometer Line. Instrument Division of Manning, Maxwell & Moore, Inc.

4 Steam Control—Monographs on steam and combustion control are the subjects treated in a series of three sections. No. 1 deals with control of steam pressure; No. 2 with combustion control from changes in steam pressure; No. 3 with automatic control for underfeed stokers. The Hays Corp.

5 Controls—Good Control of Temperature is the title of a recently released pamphlet dealing with automatic controllers for the control of temperatures ranging from —60 to +1000 deg. F. The Foxboro Co.

6 Gas Charts—Helpful engineering information in chart form on fuel gas analysis, steam leakage, psychrometry, pipe data comparative fuel costs and an oil measurement

Rigidly Inspected

AND CLOSELY HELD WITHIN TOLERANCE SPECIFICATIONS

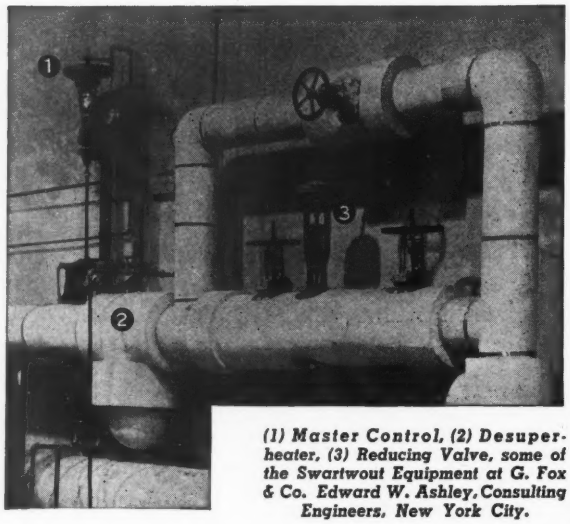
In addition to careful and thorough inspection — accurate gauging for wall thickness and outside diameter — Globe Seamless Tubes are subjected to such hydrostatic pressure tests as may be specified.

Globe engineers are at your service in selecting a tube with the exact characteristics you require. Check with a Globe engineer before you specify boiler tubing.

GLOBE STEEL TUBES COMPANY, 4012 W. Burnham St.
Milwaukee, ***Wisconsin***

GLOBE STEEL TUBES
Seamless for Safety

STAINLESS TUBES
BOILER TUBES
CONDENSER AND HEAT EXCHANGER TUBES
MECHANICAL TUBING



(1) Master Control, (2) Desuperheater, (3) Reducing Valve, some of the Swartwout Equipment at G. Fox & Co. Edward W. Ashley, Consulting Engineers, New York City.

How Swartwout Assures You Safety and *Low-Cost Power Control*•

COMPLETE EQUIPMENT FOR
Desuperheating • Differential Pressure Control • Feed Water Regulation • Pressure Reduction

WHEN it's your responsibility to engineer a *safe* economical plan for power control in your plant or building, it's wise to consider "Swartwout" for the whole job.

Suppose you have a problem similar to that of G. Fox & Co., Inc., Hartford, Conn., where initial steam at 400 lbs., 150° superheat requires three pressure reductions and two temperature reductions, with safety a paramount factor. Swartwout complete service for preparation and regulation of feed water and for control of the delivered steam assures you year-after-year efficient operation, uniform results, and unusual freedom from costly repairs and replacements, as hundreds of engineers have found.

Simple design, rugged construction, easy adjustment features make Swartwout Controls constantly dependable. You save money, cut operating costs, get trouble-free efficiency from Swartwout's broad knowledge and over 34 years of power plant experience. Write today for free advice on your control problems.

THE SWARTWOUT COMPANY
18541 Euclid Avenue • Cleveland, Ohio

Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout
•Power Plant Equipment•
Also Industrial & Commercial Roof Ventilators

table at 60 deg. F. Included with this information is a calendar for the year 1941. The Brown Instrument Co.

Pumps, Blowers and Water Treatment

7 Pumps—Two new 4 pp. Bulletins 228-1 and 229-1 describe two stage volute centrifugal pumps. These include specifications, sectional views, rating tables and dimensions. Warren Steam Pump Co., Inc.

8 Pumps—Performance of Propeller Pumps have been made the subject of an investigation and complete reports with engineering graphs giving the full results are obtainable. Peerless Pump Division of the Food Machinery Corp.

9 Pumps and Ejectors—Bulletin W-325-B1 deals with single-stage condensate pumps, Type JZ; Bulletin W-341-B2A saddle-mounted vertically split centrifugal pumps, single and two-stage volute; steam-jet ejectors, Bulletin W-205-B6B for single stage, and Bulletin W-205-B8 for two-stage. Worthington Pump & Machinery Corp.

10 Centrifugal Pumps—Two new bulletins 228-1 and 229-1 two stage centrifugal pumps have recently been released. They include specifications, special features, sectional views, rating tables, and dimensions. Warren Steam Pump Co., Inc.

11 Liquid Proportioner—An 8 pp. bulletin describes and illustrates the improved Nelson Chemical Proportioning Pump with synchronized drive. The fluid piston principle is explained, also improvements in design to increase efficiency, convenience and utility. D. W. Haering and Co., Inc.

12 Blowers—A 6 pp. folder, Form No. R-5341, is devoted to positive displacement blowers for raw water ice plant service. A curve graphically illustrates the volume and power characteristics of positive displacement blowers; also included is a condensed selection table, covering capacities of blowers at pressures of 2 and 3 lb., and at varying speeds. Roots-Connersville Blower Corp.

13 Water Treatment—New booklet, The Water Treatment Science of Tomorrow in Today's Engineering, explains the theory of organic colloidal action and briefly discusses the modern trend in water treatment. Issued by American K. A. T. Corp.

14 Cooling Water Treatment—Recently released Bulletin 1000.20 illustrates and describes the treatment for reducing slimes and increasing efficiency in condensers. Proportioneers, Inc.

15 Water Softening—A new 48 pp. catalog known as Publ. 3000 deals with hot process water softeners for removal of hardness, silica, and other scale-forming material from boiler feed and industrial process waters. The book contains a 9 pp. appendix of feedwater chemistry, in addition to heat balances, flow diagrams, two-color construction drawings, and engineering tables and charts. Effective treatments for all water conditions are discussed. Various types of installations are diagrammed and considerable space is devoted to illustrations and descriptions of accessory equipments and their various functions. Cochrane Corporation.

Electrical Equipment

16 Power Transformers—A new 16 pp. illustrated bulletin tells how to apply CSP power transformers, which are completely self-protecting, completely self-contained substations for single feeder service, on municipal or industrial distribution systems.

Four pages of application data include diagrams of different distribution system arrangements for single load, multiple loads, radial feeder systems, network systems with sectionalizing equipment, and others. Transformer regulation, protection, and metering are described, with diagrams illustrating the various recommended arrangements. The bulletin is a handy reference manual for the distribution engineer's files. Westinghouse Electric & Mfg. Co.

17 Electrical Standards—A new 48 pp. bulletin entitled What N.E.M.A. Will Do In 1941, describes the 69 projects which constitute the activities and services of the National Electrical Manufacturers Association.

18 Capacitors—Bulletin 143-C describes the new improved group of pole-type capacitors for line power-factor improvement. An exclusive feature is an internal construction in which many small, series-parallel connected sections are utilized, each with impressed voltage of less than 600. This construction results in minimum heating, long life, complete absence of corona and an unusually high factor of safety. Cornell-Dubilier Electric Corp.

BADGER

THE PROVED LINE OF "PACKLESS" EXPANSION JOINTS

Stainless Steel

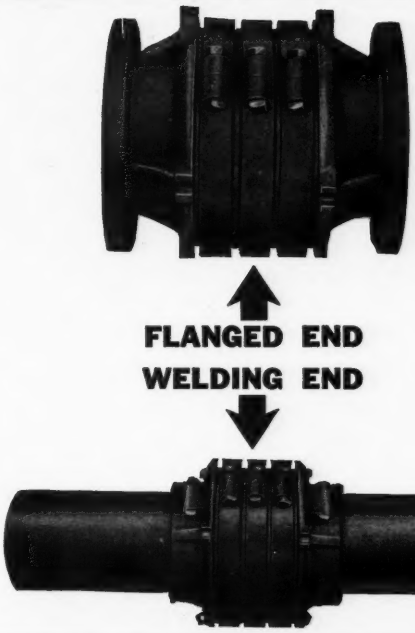
Special Copper

Directed Flexing

An exclusive, all-curve design of corrugation and equalizing rings by which flexing stresses are kept distributed, thus prolonging joint life.

Heat Treated

throughout fabrication to remove manufacturing stresses and thus assure long life



Badger "Packless" Directed Flexing Expansion Joints have been on the market for many, many years and today represent the most advanced development in expansion joints. Being packless, they require no maintenance. Being Badger Joints, they carry the assurance of many years of low-cost handling of pipe expansion problems. Ask for Bulletin 100.

BADGER

NON-EQUALIZING EXPANSION JOINT

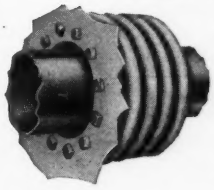
Recommended for service in lines where pressures do not exceed 25 pounds; where traverses do not exceed ½ inch; or where lateral displacement is not over ⅛" per corrugation.

Widely used for connecting equipment and lines to absorb vibration and expansion and contraction such as between pumps or compressors and lines, turbines and condensers, etc.

Bulletin 200

BADGER

FLEXIBLE PIPE LINE SEAL



A unique adaptation of the Badger "Packless" Expansion Joint to take care of those cases where piping has to pass through walls, foundations, decks or bulkheads. This joint allows for pipe movement but seals the opening to prevent water leaking in by the pipe.

Bulletin 300

E. B. BADGER & SONS CO.

75 Pitts St., BOSTON, MASS.

Agents in Principal Cities

A difficult crack problem

solved by SMOOTH-ON *Iron Cement*

This 5-ft. dia. inclined ball mill cracked between the ribs. By using Smooth-On No. 1 to make the repair, no heat was required, which eliminated the danger of causing new cracks or of spreading the old crack.

The Smooth-On No. 1 was applied under a patch plate which reinforces and strengthens the casting. The application is simple and the repair can be made in place.

Many other practical Smooth-On repairs

In innumerable other cases, too, Smooth-On has provided a practical, low-cost method of repairing cracks and stopping leaks in machinery castings, thereby avoiding production delays and expensive equipment replacements. A can of Smooth-On will return its cost many times over at each use, and Smooth-On applications require no heat, special tools or dismantling of apparatus.

FREE **The Smooth-On Handbook explains how . . .**

Contains 170 diagrams and simple, concise instructions for sealing cracks in boilers, heaters, pumps, process apparatus, valves, piping, etc.—stopping leaks at seams, bolts, rivets, joints, etc.—tightening loose parts of equipment and fixtures—making up leak-proof pipe joints—waterproofing walls, floors, tanks, cisterns, etc., and many other repair and maintenance jobs. Send the coupon TODAY for your copy.

Get Smooth-On in 7-oz., 1-lb. and 5-lb. cans or 25-lb., 100-lb. kegs from your supply house, or if necessary from us. **For your protection, insist on Smooth-On, used by engineers and repair men since 1895.**

SMOOTH-ON MFG. CO., Dept. 31
570 Communipaw Ave., Jersey City, N. J.

Please send SMOOTH-ON HANDBOOK.

Name .....

Address .....

.....

.....

4/41 .....

Do it with **SMOOTH-ON**

19 Motors—High speed induction motors for direct connection are treated in folder GEA-978B; direct current motor maintenance in GEA-3488; and tellurium portable cable in GEA-1918P. General Electric Co.

20 Motor Control—Selecting control for d.c. motors is illustrated and described in bulletin GEA-3531. General Electric Co.

21 Starter—Full-voltage magnetic starter for 1 or 3-phase, 1½ to 7½ hp. induction motors is shown in circular GEA-841K; also adjustable speed variator in sizes 1 to 15 hp. in circular GEA-3517. General Electric Co.

Power Transmission and Materials Handling

22 Magnetic Drives—Characterized as "the newest word in boiler plant language," the E. M. Magnetic variable speed drive, its advantage, characteristics, application, advantages and control, with photographs are covered in a new 12 pp. bulletin. A supplementary 2 pp. sheet is devoted exclusively to the Commerce St. Station installation in Milwaukee. The Electric Machinery Mfg. Co.

23 Speed Transmission—Graham variable speed transmissions, with non-stop reverse are described in manual 501, which has curves and diagrams of performance and notes on typical installations. Sizes are ⅛ to 1½ hp. and a 3-hp. unit is under way. Graham Transmissions, Inc.

24 Industrial Friction Materials—Bulletin FM-7A gives comprehensive data on the complete lines of industrial brake linings and blocks and clutch facings for all types of industrial equipment. A chart and tables simplify the selection of the most suitable friction material for any specified service; give recommendations for specific types of clutches and brakes; and recommend service conditions for each of the various types of J-M industrial brake linings and blocks and clutch facings. Johns-Manville Co.

25 Speed Reduction—The new American Reduction Drive is illustrated and described in a recently released catalog. The catalog used in conjunction with the American wedge belt Drive catalog, supplies all information necessary to lay out a complete mechanical drive. The American Reduction Drive is a new and economical method of providing driven speeds between 11 and 215 r.p.m. A reduction unit mounts directly on the drive shaft, as easily and quickly as a pulley. Output speeds can be easily changed by changing the ratio of the primary drive. The American Pulley Co.

26 Rubber—A new attractively colored booklet describes in non-technical language the Hycar type of synthetic rubber which is handled like natural rubber and of the oil resistant type. Included with comparative properties of Hycar and natural rubber are illustrations of its manufacture. B. F. Goodrich Co.

27 Conveyor—Free-Flow Vibrating conveyors and feeders are described in a new 4 pp. colored catalog. Operating on the lift-throw principle these conveyors and feeders are designed so as to actually suspend the mass in mid air with only momentary contact with the trough on the upward period. Oscillating arms which actuate the trough are mounted in special rubber bushings. Self-alining precision ball bearing are used throughout. Standard Transmission Equipment Co.

28 Belting—An entirely new type of conveyor belt in which the plies are made of cord instead of fabric, is described in Catalog 2300. Special features include its resistance to impact, natural troughing, low stretch and flexibility. Included with the illustrations is a cross section of the belt construction. B. F. Goodrich Co.

29 Bronze—A completely new 76 pp. catalog No. 410 describes fully, stock sizes of bearing bronze. Included are sections on general purpose bearings, graphite bearings, self-oiling bearings and electric motor bearings; also, sections devoted to oil grooving, universal cored bars, hexagon bars, babbitts, decimal equivalents, warehouses and a special 24 pp. inserted price list. Johnson Bronze Co.

Miscellaneous

30 Insulators—A recently released folder deals with characteristics and specifications of black and yellow varnished fibreglas which is used as insulation material. Irvington Varnish & Insulator Co.

31 Dust Collectors—A new 12 pp. booklet deals with the controlling of dust conditions in industrial plants. Each of the three types of American Dust Collecting Equipment, "Dustube" Dust Collector (Knocked-down and Assembled types), High Efficiency Cyclone Dust Collector and the Wet

Disposal Unit are briefly explained and illustrated. American Foundry Equipment Co.

32 **Refractory**—Bulletin R-34 describes ramming refractory of plastic-chrome for patching and lining furnaces. Refractory and Insulation Corp.

33 **Industrial Products**—A new 52 pp. Bulletin GI-6A titled Johns-Manville Industrial Products gives information on high and low-temperature insulations for industrial uses at temperatures from—400 to +2500 deg. F. Refractory materials, roofing and siding, partitions, flooring, conduits and electrical insulating materials are also covered. Johns-Manville Co.

34 **Refrigerating Equipment**—Bulletin WP-1099-B27 describes various types of air conditioning and refrigerating units, liquid cooling systems, shower condensers and coolers, ammonia and angle gas engine compressors, and other refrigerating equipment. Worthington Pump & Machinery Corp.

35 **Castings**—Mechanite castings for machine and engine parts, with controlled physical properties are described in a folder entitled Design With Confidence. Mechanite Research Institute.

36 **Lubricants**—Catalog 12-40 illustrates and describes the action of lubricants in bearings and the various methods of application. Lubriplate Division of Fiske Bros. Refining Co.

37 **Building Maintenance**—74 pp. of technical information for plant managers, maintenance men and superintendents, show how to do odd jobs at lower cost with better results. Flexrock Co.

38 **Welding**—A new folder relates how low temperature welding and brazing fills the gap between high temperature arc and acetylene welding and soft soldering. Complete with illustrations the folder also describes the new Castolin Eutectic Welding Alloys which are applied in fabricating machine parts, tools in all metals, also correcting already machined castings. Eutectic Welding Alloys, Inc.

39 **Finishing**—Manufacturing methods used to merit rigid standards of precision finishing on Caterpillar engines, are dealt with in a new 40 pp. 2 color catalog No. 6231 Caterpillar Tractor Co.

Use the Coupon to Get

HELPFUL BULLETINS

Bring your engineering equipment library up to date. Write in squares below with pencil the bulletin or catalog numbers you desire. Then detach and mail this coupon promptly.

POWER PLANT ENGINEERING April '41
53 W. Jackson Blvd., Chicago

Please have the manufacturers send me, without obligation, the bulletins indicated by numbers.

☐ ☐ ☐ ☐
☐ ☐ ☐ ☐

Name .....

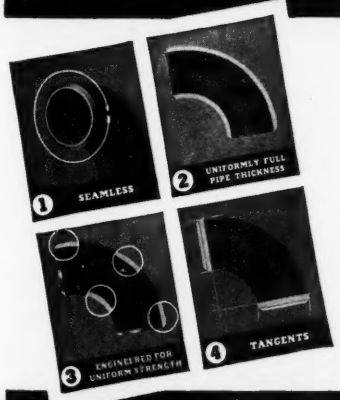
Title .....

Company .....

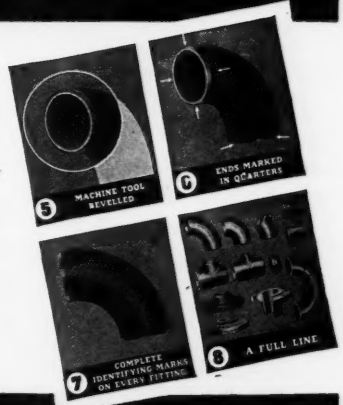
Address .....

(If you prefer delivery at your home, write address in margin)

TAYLOR FORGE



For
MAXIMUM ECONOMY
use WeldELLS, the fittings that offer you more features than any other welding fittings to speed welding and guard against trouble



Seamless Pipe Fittings **WeldELLS** **For Faster, Easier Welding**

TAYLOR FORGE & PIPE WORKS: General Offices and Works: Chicago, P.O. Box 485
New York Office: 50 Church St., Philadelphia Office: Broad Street Station Bldg.

Power Plant Construction News

Colo., Center—City Council has preliminary plans under way for new municipal power plant, using Diesel engine-generator units and auxiliary equipment. Fund of $125,000 has been authorized at special election for project, including electrical distribution system, and bonds will be arranged in that amount.

Ind., Evansville—Southern Indiana Gas & Electric Co., Evansville, plans expansion in local steam-electric power station, with installation of new 20,000-kw. turbine-generator unit and accessories, high-pressure boiler, condenser and auxiliary equipment.

Ky., Hazard—Kentucky & West Virginia Power Co., Hazard, has authorized fund of about $4,300,000 for expansion and improvements in 1941, including extensions in power plants, substations, transmission and distributing lines, and other operating facilities. Work is scheduled to begin early in spring.

Ky., Paducah—Jackson Purchase Rural Electric Co-operative Corporation, Paducah, C. D. Harris, manager, is at head of project to construct and operate a large steam-electric power plant in western part of state, for power supply for new synthetic ammonia plant to be constructed by Government at West Henderson, Ky., and for service for group of about 22 rural electric organizations in this and other parts of Kentucky. Cost reported over $5,000,000. Proposed to secure Federal appropriation for project.

Md., Baltimore—Consolidated Gas, Electric Light & Power Co., Lexington Building, will begin work at once on proposed new steam-electric generating plant in Riverside district, to be equipped for initial capacity of about 50,000-kw. Contracts for certain equipment are being awarded, and orders for other requirements will be placed in near future. Project will be carried out over a period of months and is estimated to cost close to $6,500,000.

Mich., Lansing—Board of Education, Lansing, plans central-heating plant in new multi-story Western Senior High School, for which bids will be asked soon on general erection contract. Cost estimated about $1,250,000. Warren S. Holmes, Lansing, is architect.

Mich., Marysville—Detroit Edison Co., 2000 Second Avenue, Detroit, has approved plans for addition to steam-electric generating station at Marysville, with installation of new turbine-generators, high-pressure boilers and auxiliary equipment to increase capacity about 45 percent. Also will extend coal dock and provide additional handling facilities. Entire project will be carried out over a period of months and will cost approximately $7,000,000.

Mich., Wyandotte—Municipal Service Commission has completed plans for expansion and improvements in municipal power plant to double present capacity, and will carry out work over a period of 12 to 18 months. Work will include installation of new 6000-kw. generating unit, boiler and auxiliary equipment. Cost estimated about $500,000. Awards for certain equipment are being made, with orders for other requirements to be placed as program proceeds. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

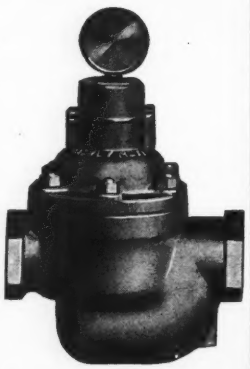
Mo., St. Louis — McQuay-Norris Mfg. Co., 2320 Marconi Avenue, manufacturer of piston rings and kindred products, plans installation of electric power equipment in new plant in vicinity of city for production of armor

Do you want to KNOW why HENSZEY BOILER FEED WATER METERS

should be used to accurately measure such ordinarily "hard-to-measure" liquids as BOILER FEED WATER, HOT DIRTY BLOW-DOWN, CONDENSATE, FREE RUNNING CHEMICALS, and many others?

HERE'S WHY!

- They are placed right in the line.
- They accurately, and continuously, measure the pulsating discharge of reciprocating pumps.
- All moving parts subject to wear are easily replaced.
- The entire mechanism can be removed from the meter without removing the body of the meter from the line.
- The operation of the meter is not dependent upon close clearances at any point.
- Meters can be calibrated to read in Gallons, Pounds, or Cubic Feet, at any specified temperature.
- Sizes: 10 to 600 G.P.M. cold water, steady flow rating. Connections: ¾" to 4". Special sizes to order.



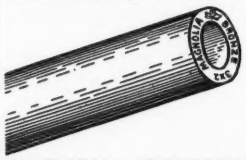
Don't delay—write for more information stating your specific problem. No obligation for recommendations.

HENSZEY COMPANY, Dept. C4, Watertown, Wis.

HENSZEY

USE the full Magnolia Line!

ADAMANT
SUPER GENUINE BABBITT



MAGNOLIA ISOTROPIC
MACHINED
DIE-CAST BRONZE

MAGNOLIA
ANTI-FRICTION METAL

. . . for airplane, Diesel and other internal combustion engines

ADAMANT Super-Genuine Babbitt

For connecting rods, trap rock crushers and automotive service. A tough homogenous alloy that will not crack under extreme shock or explosion. Free of lead and other impurities. Conforms to specifications of all recognized engineering authorities.

MAGNOLIA METAL CO.

120 Bayway, Elizabeth, N. J.
San Francisco, Cal. Fort Worth, Tex.
Montreal, Can.

MAGNOLIA BEARING METALS

piercing cores for small arms ammunition for War Department. It will consist of several large production units. Entire project will cost about $4,460,000 and appropriation in that amount will be secured from Government for project.

Ohio, Dover—City Council plans extensions and improvements in municipal power plant, including installation of additional equipment. Estimates of cost will be made soon. Waldo Hartline is city engineer, in charge.

Ore., Portland — Reynolds Metals Co., Federal Reserve Bank Building, Richmond, Va., plans installation of electric power equipment in new two-unit plant for the production of aluminum, on site to be selected soon in Oregon, at point near route of Bonneville transmission system, from which power supply will be secured. Company has concluded contract with Administrator of Bonneville Project, Portland, for service noted, on basis of connected load of about 40,000-kw. Entire project is reported to cost over $10,000,000.

Pa., Northampton—Universal Atlas Cement Co., 135 East Forty-second Street, New York, N. Y., plans installation of electric power equipment in new cement mill at Northampton, on which work will proceed at once. A steam power house is proposed. Entire project will cost close to $5,000,000.

Pa., Philadelphia — Pennsylvania Forge Corporation, Milnor and Bleigh Streets, manufacturer of steel forgings, plans installation of electric power equipment in connection with expansion in plant for production of heavy and other forgings for Navy Department. Cost estimated about $2,500,000, and fund in that amount will be provided by Government for project.

S. D., Watertown — City Council will receive bids until April 7 for extensions and improvements in municipal power plant, including installation of equipment, comprising cooling tower, pumping machinery, switchboard, piping and auxiliary apparatus. Cost estimated about $165,000. Ralph D. Thomas & Associates, 1200 Second Avenue South, Minneapolis, Minn., are consulting engineers.

Texas, Freeport — Dow Chemical Co., Midland, Mich., plans installation of electric power equipment in new addition to magnesium metal plant at Freeport, consisting of several large one and multi-story units, to double present capacity. Cost estimated about $8,000,000. Output will be for War Department and appropriation in amount noted will be provided by Defense Plant Corporation, Washington, D. C., a Federal agency. Work is scheduled to begin soon.

Texas, Lufkin — Southland Paper Mills, Inc., plans installation of electric power equipment in connection with proposed expansion in pulp division at local newsprint mill, where large increased capacity will be carried out. Also plans extensions in power house at mill. Fund of about $3,000,000 has been authorized for project, with financing through RFC and sale of stock. George F. Hardy, 305 Broadway, New York, N. Y., is consulting engineer.

Utah, Tooele—International Smelting & Refining Co., 25 Broadway, New York, N. Y., plans installation of electric and other power equipment, furnaces, firing equipment, etc., in new zinc-smelting plant at properties at Tooele, to be located on site adjoining present lead-smelter of company. It will have capacity of about 30 tons of zinc per day. Cost estimated close to $300,000. Completion is scheduled by close of this year. Company is a subsidiary of Anaconda Copper Mining Co., first noted address.

Va., Lynchburg—Appalachian Electric Power Co., Roanoke, Va., plans extensions and improvements in properties in Lynchburg district, including power substations, transmission and distributing lines, and other operating facilities. Program will be carried over a period of 18 to 24 months, and is estimated to cost about $335,000.

Va., Narrows—Celanese Corporation of America, Inc., 180 Madison Avenue, New York, N. Y., manufacturer of rayon products, plans installation of electric power equipment in new additions to branch mill near Narrows. Entire project will cost about $1,500,000. Work is scheduled to begin soon.

Wash., Seattle—Cascade Machinery Co., 4600 East Marginal Way, has approved plans for new boiler house at plant, 25x30 ft., with steel stack, and will begin erection soon. Clare Moffitt, 5622 Eleventh Avenue, N.E., is architect.

Wash., Seattle — Department of Lighting, Third Avenue and Madison Street, is arranging fund of about $884,000 for expansion and improvements in plants and system during 1941.

Find out what WEDGE CHILL RINGS will do for YOU! THEY

Split Feature Patented

1 → SAVE LABOR
2 → SAVE MATERIAL
3 → SAVE TIME

Remember that WEDGE Chill Rings are different—they have an exclusive patented SPLIT Feature that enables them to serve where ordinary rings fail. With the SPLIT Feature you are sure of a PERFECT FIT. WEDGE Chill Rings save money because you can weld FASTER and get a STRONGER job—this eliminates the possibilities of welding failures. They are made of welding material which assures a perfect bond. It will pay to learn what WEDGE Chill Rings will do for you—they are saving money for others.

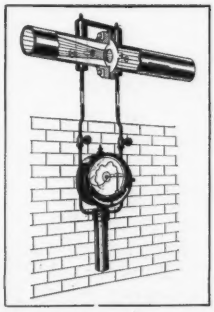
Write for Circular and Prices

WEDGE PROTECTORS, INC.
9526 Richmond Ave. Cleveland, Ohio

WEDGE CHILL RINGS SAVE MONEY

ADSCO FLOW METER, Orifice Type
ACCURATELY METERS STEAM, WATER, AIR OR GAS

Reasonable in Cost
Easy to Install



A Typical installation of a wall mounted meter showing orifice plate above meter.

The ADSCO Flow Meter has a record of *exceptional accuracy* at all rates of flow. It is highly sensitive to fluctuations in flow but cannot be damaged by sudden overloads or reverse flows.

Free floating, frictionless meter mechanism transmits flow to direct reading, evenly divided chart.

Available with recording chart, indicating scale and integrator counter to totalize the flow or in other combinations of these three devices.

Correspondence is invited regarding your metering problems so that ADSCO may make recommendations based on over 25 years' experience in the manufacture of meters.

Write for Bulletin No. 35-83E

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
IN BUSINESS OVER SIXTY YEARS

Where to Buy DIRECTORY

AIR COMPRESSORS
De Laval Steam Turbine Co.
Pennsylvania Pump & Compressor Co.
Worthington Pump & Machy. Corp.

AIR PREHEATERS
Air Preheater Corp.
Babcock & Wilcox Company, The
Combustion Engrg. Co., Inc.
Foster Wheeler Corporation

AIR WASHERS
American Blower Corp.
Badger & Sons Co., E. B.

ANTI-CORROSIVE COATINGS
Dampney Co. of Amer.
National Engrg. Products, Inc.

ANTI-FRICTION METAL
Magnolia Metal Co.

ARCHES, BOILER & COMBUSTION
Detrick Co., M. H.
Norton Company

BAFFLES, BOILER
Engineer Co., The

BEARINGS, ANTI-FRICTION BALL AND ROLLER
Link-Belt Company

BEARING METAL
Magnolia Metal Co.

BELTING, SILENT CHAIN
Morse Chain Co.

BLOWERS, FAN AND FURNACE
American Coal Burner Co.
De Laval Steam Turbine Co.
Wing Mfg. Co., L. J.

BLOWERS, FORCED DRAFT, PORTABLE PRESSURE AND COAL
Wing Mfg. Co., L. J.

BLOWERS, TURBINE
Elliott Company
Terry Steam Turbine Co., The
Wing Mfg. Co., L. J.

BOILER BLOW-DOWN SYSTEMS
Cochrane Corporation
Hensxey Company
National Aluminate Corp.

BOILER COMPOUNDS
Buromin Co., The
Dearborn Chemical Company
Garratt-Callahan Co.
Haering & Co., Inc., D. W.
Sugar Beet Products Co.

BOILER FEED WATER PURIFYING APPARATUS
Permutit Co., The

BOILER SETTINGS
Detrick Co., M. H.
Engineer Co., The
Norton Company

BOILER SETTING CEMENT
Norton Company

BOILER & TURBINE COATINGS
Dampney Co. of Amer.

BOILER TUBES
Babcock & Wilcox Tube Co.
Globe Steel Tubes Co.

BOILER WATER TREATMENT
Buromin Company, The
Dearborn Chemical Company
Garratt-Callahan Co.
Hall Laboratories, Inc.
Haering & Co., Inc., D. W.
National Aluminate Corp.
Permutit Co., The

BOILERS, POWER AND HEATING
Babcock & Wilcox Company, The
Combustion Engrg. Co., Inc.
Foster Wheeler Corporation
Keeler Co., E.
Murray Iron Works Co.
Springfield Boiler Company
Vogt Machine Co., Inc., Henry
Wickes Boiler Co., The

BOOKS
Audel & Co., Theo.

BRONZE BAR STOCK
Magnolia Metal Co.

BURNERS, COAL, PULVERIZED
Peabody Eng'r'g. Corp.

BURNERS, GAS
Peabody Eng'r'g. Corp.

BURNERS, OIL
Peabody Eng'r'g. Corp.

BURNERS, OIL AND GAS, OIL AND COAL, GAS AND COAL
Peabody Eng'r'g. Corp.

BURNERS, WIDE RANGE OIL
Peabody Eng'r'g. Corp.

CABLEWAYS
Sauerman Bros., Inc.

CEMENT, IRON
Smooth-On Mfg. Company

CEMENT, REFRACTORY, ACID PROOF, FURNACE AND HIGH TEMPERATURE
Babcock & Wilcox Company, The
Ehret Magnesia Mfg. Co.
Norton Company
Kellogg Co., The M. W.

CHAINS, CONVEYOR, ELEVATOR AND DRIVE
Link-Belt Company

CHAINS, DRIVE
Morse Chain Co.

CHAIN WHEELS
Babbitt Steam Specialty Co.

CHEMICALS, WATER TREATING
Betz, W. H. & L. D.
Buromin Company, The
Calgon, Inc.
Dearborn Chemical Company
Garratt-Callahan, Inc.
Haering & Co., Inc., D. W.
National Aluminate Corp.
Permutit Co., The
Sugar Beet Products Co.

CHIMNEYS
American Chimney Corp.

CLEANING COMPOUNDS
Calgon, Inc.
Dearborn Chemical Company

COAL, ASH HANDLING AND STORAGE EQUIPMENT
Fairbanks, Morse & Co.
Sauerman Bros., Inc.
Syntron Company

COAL CRUSHERS
American Pulverizer Co.
Link-Belt Company

COALS, STOKER, GAS SCREEN
Chesapeake & Ohio Lines
Pittsburgh Coal Co.

COAL WEIGHING AND MEASURING EQUIPMENT
Richardson Scale Co.

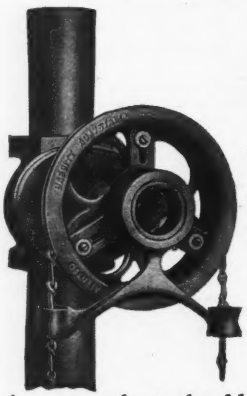
COCKS, AIR AND STEAM
Crane Co.
Dart Mfg. Company, E. M.
Fairbanks Company, The
Lunkenheimer Co., The
Nicholson & Co., W. H.
Williams Valve Co., The D. T.

COILS & BENDS, PIPE
Badger & Sons Co., E. B.

COMBUSTION CONTROL SYSTEMS
American Coal Burner Co.
Bailey Meter Company
Cash Company, A. W.
Engineer Co., The
Hagan Corporation
Hays Corporation, The

COMBUSTION RECORDERS
Brown Instrument Co., The
Hays Corporation, The
Permutit Co., The

For All "HIGH-UP" VALVES



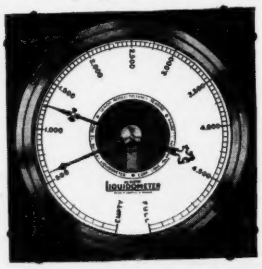
Every overhead valve in your plant should have the easy, safe, instant control from the floor which Babbitt Sprocket Rims provide. . . . Babbitt Rims are low in cost; quickly attached; they save time, steam and accidents. Install them now. Write for descriptive folder.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass., U. S. A.

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

The Importance of Accurate Liquid Control
Demands A **LIQUIDOMETER**
The Dependable Tank Gauge for All Liquid Measuring

Many satisfied industrial users attest to the perfect year in and year out efficiency of their LIQUIDOMETER tank gauges. Convenient, hazard-free, 100% Automatic — these tank gauges insure accurate readings whenever required.



No pumps, valves or auxiliary units required to read levels. Balanced hydraulic transmission system completely compensates for temperature variations on communicating tubing. Accuracy unaffected by changes in specific gravity.

Approved for gauging hazardous liquids by Underwriters' Laboratories and other similar groups.

Models are available for REMOTE signals, automatic control of pumps, etc. Direct Reading models may also be installed where remote reading is not desired.

Write for complete details.

THE **LIQUIDOMETER** CORP.
36-31 SKILLMAN AVE., LONG ISLAND CITY, N.Y.